NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

THOR3: HUMANS ARE MORE IMPORTANT THAN HARDWARE

by

Benjamin W. Knipscher

December 2010

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REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington DC 20503.			
1. AGENCY USE ONLY ***(Leave blank)***	**2. REPORT DATE** December 2010	**3. REPORT TYPE AND DATES COVERED** Master's Thesis	
4. TITLE AND SUBTITLE THOR3: Humans Are More Important Than Hardware		**5. FUNDING NUMBERS**	
6. AUTHOR(S) Benjamin W. Knipscher			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000		**8. PERFORMING ORGANIZATION REPORT NUMBER**	
9. SPONSORING /MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A		**10. SPONSORING/MONITORING AGENCY REPORT NUMBER**	
11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government. IRB Protocol Number ___N/A____			
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited		**12b. DISTRIBUTION CODE**	

13. ABSTRACT (maximum 200 words)

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14. SUBJECT TERMS Ranger Athlete Warrior Program (RAW), Army Physical Fitness Test, Athlete's Performance Institute (API), National Strength and Conditioning Association (NSCA), Naval Special Warfare (NSW), Progressive muscle relaxation, Personal Protective Equipment (PPE) Restricted Environment Stimulation Therapy, Special Warfare, THOR3, TSAC, Tactical Strength and Conditioning, DEVGRU, Cognitive, Neurology, Emotions, Rehabilitation, Rest, Recovery, Facility, Nervous System, Fatigue, Injury, Hydrotherapy, Electrolytes			**15. NUMBER OF PAGES** 135
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	**18. SECURITY CLASSIFICATION OF THIS PAGE** Unclassified	**19. SECURITY CLASSIFICATION OF ABSTRACT** Unclassified	**20. LIMITATION OF ABSTRACT** UU

NSN 7540-01-280-5500 Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. Z39.18

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THOR3: HUMANS ARE MORE IMPORTANT THAN HARDWARE

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Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN DEFENSE ANALYSIS

from the

NAVAL POSTGRADUATE SCHOOL
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ABSTRACT

This thesis outlines the implementation of the United States Special Operations Command THOR3 (Tactical Human Optimization, Rapid Rehabilitation and Reconditioning) Program into the Special Operations (SOF) community. This study returns to basics by focusing on the irreplaceable human element of SOF operations and identifies specific steps to prepare the human weapons system for the variety of SOF challenges it faces. Specifically, the study analyzed program design considerations and methods to better educate, train, and monitor SOF Soldier physical development and, when required, to recondition and rehabilitate SOF individuals back to full operational status after an injury.

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LIST OF ACRONYMS AND ABBREVIATIONS

APFT	Army Physical Fitness Test
API	Athlete's Performance Institute
COC	Chain of Command
NSCA	National Strength and Conditioning Association
NSW	Naval Special Warfare
PMR	Progressive muscle relaxation
PPE :	Personal Protective Equipment
REST	Restricted Environment Stimulation Therapy
SME	Subject Matter Expert
SPECWAR	Special Warfare
SOF	Special Operations Community
SWAT	Special Weapons and Tactics
THOR3	Tactical Human Optimization, Rapid Rehabilitation and Reconditioning program
TSAC	Tactical Strength and Conditioning Program

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ACKNOWLEDGMENTS

The successful completion of my thesis attributes to a group of people too long to list. Up front, I apologize for my inability to thank personally all the Naval Postgraduate School professors and others who helped shaped this research project, but just know that all of you made a substantial impact in my life and your help was greatly appreciated.

There are certain people; however, who deserve special recognition for their help and efforts. Their guidance and patience provided me a much more holistic education that I would have experienced otherwise.

First, I would like to thank my thesis advisor, LTC (Ret) Danny McMillian. Assuming thesis advisor responsibilities while simultaneously developing your own teaching curriculum adds to the testimony of character and dedication you demonstrated throughout your Army career, your family and your friends. I truly appreciate your patience with my questions and, dare say, shenanigans, through this educational process. Your patience, guidance, and willingness to accept this project prevented a tremendous amount of friction and academic heartache while trying to understand new concepts and material. My time underneath your tutelage was a truly enjoyable and remarkable experience.

I would also like to thank my second reader, Leo Blanken. I had a great time working with you throughout my time at Naval Postgraduate School, both in the classroom and in the ring. I am going to miss our lunchtime and weekend hammer fests. Your ability to take small ideas and conceptualize them into the big picture kept my thoughts and ideas into perspective throughout the research process.

Small seeds grow into great oaks. The seed for this thesis started while working with Mark Stephenson at the National Strength and Conditioning Association headquarters in Colorado Springs. Mark, thanks for letting this young man continue to be a player. The coaching you provided not only me, but the rest of the 10th Special Forces Group was, and continues to be, invaluable.

To my combative instructors Grand Master Mike Pick, Gabe Fabela, Ron Rose, Dr. Richard Riehle, Gary Parker, Mark Miskelley, and Dr. Richard Schmidt. When all the accoutrements, tabs, badges, titles and awards are stripped away to reveal what lies in the heart of a SOF Soldier, it quickly becomes apparent if the fundamental and embryonic foundation of tactics, strategy and maneuver are sound enough to win in perhaps the ultimate test of SOF human performance. Man truly does sharpen man.

Most importantly, I would like to thank my family. While the seed for this thesis started in Colorado Springs, the seed for my development as a man and citizen of this great nation and the world started with my upbringing. Mom, Dad and Jonathan, I could not ask for better parents and brother. Thank you for giving me strength and guidance to enable me to stand on my own two feet and battle through life's challenges while also allowing me to become the independent thinker I am. Life's fundamentals lay early, and the upbringing you provided me continues to help me navigate the path of life.

With independent thinking comes intellectual curiosity and drive for success. Curiosity and drive sometimes cause friction. Countering this friction is a force of common sense, peace of mind and serenity. This force is called Scotte. Her ability to deal with adversity while managing our household and children allowed me the freedom of movement to complete this project while continuing to develop professionally and personally. I dedicate this work to her.

I. THOR3: HUMANS ARE MORE IMPORTANT THAN HARDWARE

> Let therefore the youth who is to be chosen for martial tasks have observant eyes, hold his head up, have a broad chest, muscular shoulders, strong arms, long fingers, not too extended waste measure, lean hams, and calves and feet not extended with superfluous flesh, but hard and knotted with muscles. Whenever you find these in a recruit, do not be troubled with his height. It is more useful for Soldiers to be strong and brave than big.
>
> Publious Flavious Vegetius, *Epitoma Rei Militarias,* circa 383

To achieve mission success in Overseas Contingency Operations (OCO), Special Operations Forces (SOF) must be able to withstand extraordinary physical demands and psychological stress. Warfare, despite advances in weaponry, technology, training methods and medical care, still places members of the Armed Forces under the same difficult, stressful situations as it did when Publious was writing his military tome 1,600 years ago. The mental and physical hardship is even greater for the Special Operations Forces (SOF) leading the way at the tip of the spear, particularly since the operational tempo and deployment increase since 9/11.

Like the constant warfare of ancient Rome, operational tempo and the physical toll of battle will continue unabated in the near future. As continuous and long deployment cycles see an increase of injuries from heavy loads of Personal Protective Equipment (PPE), maneuvering up and down difficult terrain, the anticipated stress and constant training schedule grind without an “off-season,” and It is more important than ever to maintain focus on the SOF truth that “Humans Are More Important than Hardware.” To keep SOF healthy and operating at its maximum potentiality, the United States Special Operations Command (USSOCOM) recently signed an $84 million dollar Tactical Human Optimization, Rapid Rehabilitation and Reconditioning (THOR3) initiative. This program is designed to integrate the latest advances in the human performance

and rehabilitation fields within the SOF community, as well as off-the-shelf Professional Sports Models (PSMs) training and rehabilitation protocols and knowledge. The applicable lessons from this thesis are straightforward and simple. For starters, Chain of Command (COC) and soldier buy-in and support must occur for the program to achieve its success. Lack of buy-in will mitigate any positive effects without top driven priority and grass-root emphasis. The THOR3 program is the first attempt by the SOF community to properly plan, resource, and implement a physical training program that matches the physical requirements found on the modern battlefield. Concomitant with this is that the THOR3 intends to enhance the durability, resiliency, and adaptability of a SOF soldier for a 25-year career by placing functional movement before functional performance or skill. The better the level of fitness soldiers attain prior to practicing technique the more effective the technical improvements are because the athlete is not attempting to train fitness (organic) and practice technique (neurological) at the same time (Twight, 2004). Although this method is relatively safe, trainers must ensure that Soldiers are doing the basics right at all times. Improper functional movement at the embryonic stages will almost certainly guarantee improper functional skill later. The amount of weight lifted, improved run times, quicker agility, and power are indicators of overall improvement, but should not be the sole focus of the program. The last major take-away from program implementation is soldier education. As relationships between the newly hired human performance professional staff and SOF soldiers build, the training concepts and applications found in amateur and professional athletic ranks will filter into the SOF community and add to the soldiers' professional development.

A. THE PROBLEM

1. Inadequate Doctrine and No Training Pathway

To date, Army physical fitness programs were heavily influenced by the American College of Sports Medicine. Tailored for the civilian population, these programs did not reflect Soldier tasks. Traditional unit PT programs consisted of unstructured and unsystematic daily runs, and usually some version of callisthenic exercises that focused more on aerobic versus anaerobic fitness. While individual and unit programs did a relatively good job maintaining as semblance of “fighting fitness,” these programs fell way short of enabling a Soldier to reach his or her maximum human performance potentiality without a baseline strength and conditioning doctrine, training pathway, and adequate number of professionals to train and supervise the masses. Advances in human performance research and practical application demonstrate that better, more tactically oriented ways are available to enhance a Soldier's potential (Gonzalez, 2010).

The SOF community recognized that before engaging in these practical applications, a subconscious, basic understanding and integration of foundational, functional movement patterns was necessary for the SOF Soldier to accomplish to high-level functional skills. Most SOF Soldiers have a general idea of how to train for strength, agility, power and endurance; however, knowing how to maintain proper, natural anatomical alignment through difficult movement patterns is where most SOF Soldiers faulter or fail. Every group has randomly distributed individuals with natural ability who are able to see, understand, and conduct movement easily; however, enabling Soldiers to master functional movement is an extreme challenge for a human performance staff due to Soldiers' limited understanding or knowledge of biomechanics and other motion science related fields. Limited time available in packed training schedules also contributes to this recipe for human performance disaster. Gray Cook, in his book entitled *Athletic Body in Balance,* referred to this issue as the Functional

Paradigm (see Figure 1) (Cook, 2003). Many SOF warriors required to complete sometimes highly complex tasks have not mastered necessary functional movements before moving to functional performance or higher-level skill tasks. Like amateur or professional athletes, being a “Tactical Athlete” has its own set of specific physical and mental requirements; however, at the core of any successful athletic endeavor is a basic understanding of movement. Building functional movement is the same as constructing a house. All the walls, trimmings, crown molding, and other gingerbread will fall down without a solid, functional foundation upon which to build.

Furthermore, while basic movement patterns are similar in sport and combat (running, walking, etc.), it is the *application* of the movement patterns as they apply to SOF specific tasks that bear a deeper look and critical analysis, especially when a SOF Soldier must execute proper application throughout the strength continuum (see Figure 2) (Baechle, 2008). As with many endeavors, successful SOF performance enhancement lies in mastery of the basics, mental awareness, and the ability to open up and allow teaching and experience to come in unfiltered - no screens, no preconceptions, and no limitations. Due to high operational tempo, fundamental movement techniques require teaching, regular reinforcement, and integration with Soldierly tasks during physical training hours. There is one small catch, however. It is wise to think of basics as concepts and principles versus techniques. While technique specificity is critical in the beginning skill learning stages, it is important to consider specificity within its context. If not, techniques become limitations, and no basic technique, no matter how worthy or desirable, is ever an end to itself (Enos, 1990). This is especially important to the SOF community that operates in many different cultural and political contexts throughout the world. It is far better for the SOF soldier to think in concepts and principles than fall victim relying on context specific techniques in an ambiguous environment.

B. PURPOSE AND OBJECTIVES

The thesis's purpose is to recommend a THOR3 program design that will enable a SOF Soldier to reach his or her maximum human performance potentiality and prepared for any mission. By demonstrating that the attainment of proper and natural anatomical alignment, consideration of proper nutrition, adequate rest and recovery, coupled with improving physical and mental understanding of foundational movement, an increase in strength, agility, power, and endurance should occur while injuries rates decrease. Implemented and designed properly, the THOR3 program, will increase combat effectiveness by:

1) Eliminating or reducing the likelihood and severity of physical and psychological injury or disease states from enemy, occupational, and environmental hazards
2) Speed the reconditioning and return to full duty after enemy occupational and environmental injury.
3) Minimize the disruption of unit's operational tempo

C. RESEARCH QUESTION

Given USASOC's varied mission sets and requirements, unit organizational designs, personnel, and available facilities, what is the optimal THOR3 program design and rehabilitation intervention strategy?

Many program designs focus on the physical aspects of strength and conditioning while dismissing key variables of nutrition, rehabilitation, and mental training. The SOF community does not have the luxury of being one or two-dimensional. The optimal THOR3 program is a complete system that enhances the SOF soldier's overall athleticism by integrating program design variables and solid movement skills foundation with program design variables of resistance and aerobic training, nutritional and mental performance protocols. THOR3's differentiating factors from other training protocols is that it will place strict adherence to mastering foundational movements at the physical and cognitive level. Many training protocols hastily push their clients into technically challenging training routines prior the client having full and complete

understanding of the dynamic and difficult exercise techniques; they willingly sacrifice low or zero injury rates for higher client volume and profit. The THOR3 program intends to be a living, breathing system that increases SOF performance enhancement by increasing Soldier's adaptability, survivability, durability, and resiliency.

To establish a framework for academic discussion, it is necessary to provide quick commentary about military fitness as it relates to those within the SOF community. Unlike SOF's conventional counterparts, SOF missions require demands that are unique to the community. These include land, sea and air insertion and extraction techniques (some of which can days to accomplish), austere working environments beyond the norm (Navy SEALs and Explosive Ordnance (EOD) operate for hours underneath cold, icy, waters, while High Altitude, Low Opening (HALO) parachuting techniques call for “flying” a chute from nearly 25 miles away). SOF personnel also operate in situations where mental flexibility and adaptability, and political awareness are more critical than physical prowess or the ability to handle a weapon.

With these things in mind, designing a training protocol to cover the broad range of mission specific tasks is the military is inherently difficult. While SOF Soldiers must maintain a primary base of general-purpose fitness, there are times when training specificity is required to prepare for unique mission set demands. The SOF community, like many others, has been susceptible to the past and current trends of the fitness industry; many attempts to provide a doctrinal fitness definition or program quickly fell in line with the predominant marketing or media trends of the day. This is especially evident during the last decade, as hybrid workouts that incorporate a blend of resistance and endurance training have become increasingly popular. Though hybrid training protocols provide much detail about fitness components, specific tasks, or details of *what* and *how* to conduct training according to the individual or group’s definition, the main point of a SOF fitness program is missed completely by following some of these training protocols that focus on how much weight is lifted, fastest run times,

or matches won. The final analysis is about solving the functional paradigm and enhancing a Soldier's survivability, adaptability, resiliency, and durability. Acquiring individual achievement awards or profit, stifling creativity, or placing training protocols in a square theoretical framework with strict guidelines to follow is missing the point completely.

Considering this, it is necessary to advise the reader that the program design outlined in this thesis is *a* system versus *the* ultimate solution to fighting fitness. Since the gap between research and practical application continues to advance human performance understanding on a daily basis, then claiming that the program design outlined in this thesis will enable one to reach the pinnacle of human performance is shortsighted.

D. SCOPE, METHODOLOGY AND CHAPTER REVIEW

Using the heuristic case design to develop arguments, this thesis examined existing human performance programs in the SOF community, as well as professional and amateur athlete models in the NCAA and U.S. Olympic Community (Bennett, 2005). After this chapter's introduction, real program design discussion begins in Chapter II where a historical perspective of the "Battle of the Systems" is provided for the reader understand how sport's politicization and nationalization, as well as the bodybuilding and running culture influenced the military physical fitness programs until the sudden popularity of hybrid workouts took hold (Thomas, 2002).

Chapter III examines history's effects on current military physical fitness programs while also discussing three civilian strength and conditioning programs that have had a recent impact on the SOF community. Understanding budget constraints limit funding available for ordering equipment, re-furbishing or constructing training facilities, Chapter III also examines specific and necessary facility requirements and considerations required to train SOF Soldiers.

Chapter IV examines three case studies of human performance programs designed specifically for military units; these programs helped to shape the desired outcome of the THOR3 program. The first case study examines the 10th Special Forces Group-Airborne, (SFG (A)) working agreement with the National Strength and Conditioning Association's (NSCA) Headquarters, which allows 10th Group Soldiers to train at the NSCA's HQ Human Performance Center. This relationship formed the embryonic stages of the NSCA's Tactical Strength and Conditioning Program (TSAC), and continues enhance human performance and rehabilitation success of 10th Group Soldiers on a daily basis. The second case study examines the 75th Ranger the Ranger Athlete Warrior (RAW) program. The RAW program, built upon the vast experience of the small, but highly competent staff, completely changed the dynamics of Regimental fitness program, no small feat considering that the Ranger population has a large and diverse operator population in terms of age, capability, and understanding of physical fitness. The third case study examines the recent human performance program implementation by the U.S. Navy's Special Warfare Development Group (DEVGRU). Like the RAW program, the overwhelming desire and dedication of a small, highly competent staff with long experience working in the human performance industry drives DEVGRU's success.

Chapter V examines the often forgotten program design aspects of nutrition by examining best practices and fueling methods of Olympic Training Centers, the 75th Ranger Regiment, and other leading nutritional and dietary authors and manuals that provide the best possible information for fueling the tactical athlete.

Chapter VI examines the long-standing issue of Performance Enhancing Drugs (PEDs). This chapter discusses the history of PED use in sport, effectiveness, side effects, legal issues, and legal and illegal use by SOF soldiers, as well as an argument for the use of PEDs to offset the effects of aging, and testosterone loss in older SOF soldiers. Many sources were used to write the PED chapter in this thesis; however, most sources were driven from the

ground-breaking study by Dr. Shelander Bhasin, Section Chief of the Division of Endocrinology, Diabetes, and Nutrition, Boston University School of Medicine and Dr. Jay Hoffman, President of National Strength and Conditioning Association.

Chapter VII makes a few brief comments about an often-overlooked aspect of human performance: rest and recovery. Soldiers and athletes spend most of their time worrying about getting stronger, faster, and powerful, but often fail to realize the simple fact that muscle growth and power improvement does not happen during training, but during the rest periods. Failure to adapt to training stressors, either physical or psychological, can lead to detrimental conditions common to many athletes, such as overtraining, overuse or burnout.

Chapter VIII provides a brief overview of injuries and the functional rehabilitation process, discuss some common mistakes made during this process, and provide insight on critical functional rehabilitation methods necessary to ensure SOF Soldiers return to duty with little chance of re-injury. The most important take away for the reader is that the same dedication, hard work, and focus demonstrated while training is also required for the rehabilitation process to work effectively.

Chapter IX discusses mental side of the THOR3 program. Soldiers are keen on working the physical aspect of program design, but often do not take the time to understand how perception, balance, spatial orientation, emotions, improper diet, rest and recovery affect operational performance. These chapters examines conceptual emotional-cognitive-performance frameworks from leading cognitive scientists and psychologists to bridge the gap between understanding brain function and applying these lessons in the tactical environment (Tenenbaum, 2009).

Chapter X concludes this thesis with three primary considerations for THOR3's success and a way ahead for any SOF Soldier interested in expanding on this work. Due to THOR3's preventive training and health care benefits, the

chances of SOF personnel to live a successful, healthy, and injury free life after retirement greatly increased, and reduced the Veteran's Administration long-term health care costs. Although it is impossible to predict a concrete cost savings amount during the embryonic stages of THOR3 development, it is estimated that the savings will number in the millions if the program is successful.

> To the recruit trained this way the contest of battle, no matter who the enemy, will not bring dread, but joyous occasions.
>
> - Publious Flavious Vegetius, *Epitoma Rei Militarias,* circa 383

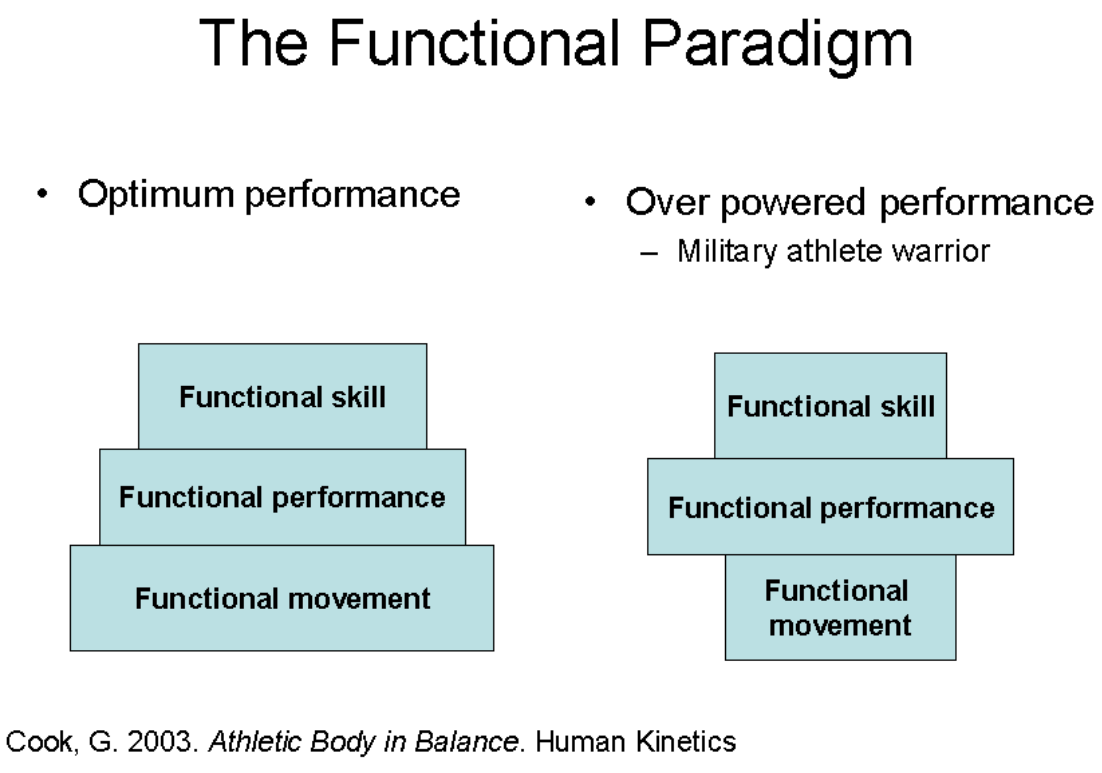
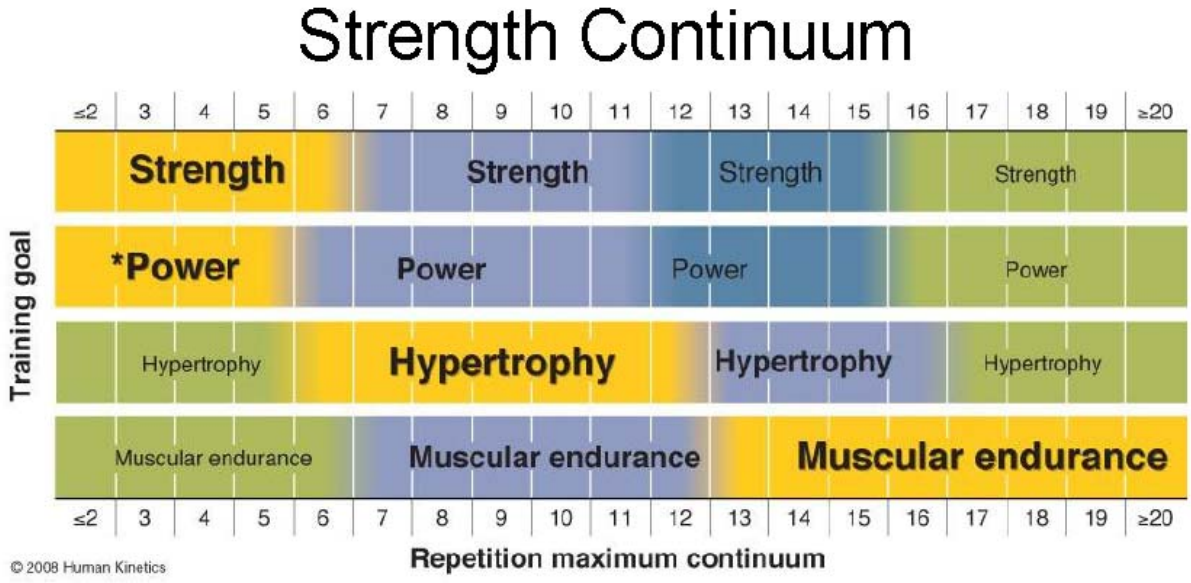


Figure 1. Functional Paradigm. (From: Cook, 2003)



The tactical athlete needs to work all along this continuum. The distribution of training will depend on individual needs and unit requirements.

Baechle TR. *Essentials of Strength and Conditioning.* Human Kinetics. 2008.

Figure 2. Strength Continuum. (From: Baechle, 2008)

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II. HISTORY AND CULTURE

The true past departs not;
no truth or goodness realized by man ever dies;
or can die; but all is still here,
through endless changes.
-Thomas Carlyle (1795–1881)

Technology, tactics, and strategy notwithstanding, a Soldier's requirement to maintain fighting fitness suitable to achieve mission requirements has changed little since warfare in the classical age. To help solve the SOF functional paradigm that sees Soldiers racing to conduct functional skill training protocols prior to learning proper functional movement, it is necessary to consider how historical and cultural influences shaped and continue to shape military program designs. By discussing historical cultural and civilian marketing forces, this chapter will provide a quick overview of how SOF physical fitness programs developed into their current state, and bring to light the difficulty that SOF soldiers face when trying to balance general-purpose fitness with specificity.

The need for physical fitness and physical training in combat is as old as war itself. In ancient Greece, citizens were required to train themselves to carry the shields and long spears of the day. The same was true for Romans of the Republic and early empire. Later, however, the physical fitness and military training of the average Roman citizen declined--a decline that helped necessitate the development of standing, mercenary armies (Krause, 2002). Vegetius, the Roman military strategist wrote of this in a letter to Emperor Valentine explaining the expectations and problems of new recruits,

> After their examination, the recruits should then receive the military mark (usually imprinted on the hands of Soldiers, either with a hot iron or in some manner), and be taught the use of their arms by constant and daily exercise. However, this essential custom has been abolished by the relaxation introduced by a long peace. The only method, therefore, that remains of recovering the ancient customs is by books, and by consulting old historians. But they are

> of little service to us in this respect, as they only relate the exploits and events of wars, and take no notice of the objects of our present enquiries, which they considered as universally known. (Phillips, 1985)

Vegetius's *De Re Militari,* was the most influential military treatise on the western world from the Roman times to the 19th Century; its impressions on the US Armed Forces traditions are evident everywhere, and his description of weapons proficiency requirement of the Roman soldier easily reminds one of the almost innumerable duties of the present day infantryman:

> Recruits were to be hardened so as to be able to march twenty miles in half a summer's day at ordinary step and twenty-four miles at quick step. It was the ancient regulation that practice marches of this distance must be made three times a month. (Phillips, 1985)

Unfortunately, the time, effort, and resources required to turn raw recruits from an unfit civilian population into an effective fighting force has changed little over the past 2,000 years. The cultural influences and fitness trends that shape the civilian population are in many ways inseparable from the fitness trends affecting the armed forces. Though the army has successfully adapted its basic training protocol to compensate for baby boomers (born between 1943 and 1960), and generation X (born between 1961 and 1980), the new all-volunteer Army comprised of a new generation of *millennials,* or people born after 1980, posed the same set of problems that Vegetius spoke of. The Millennial generation picks up concepts, understands culture, finds information, applies it quickly, and "teams" better than previous generations. Likewise, they are excellent at multi-tasking, but have a hard time focusing on one task at a time. Heavily influenced by technology in the form of video games, cell phones, and other various forms of multi-media, Millennials are much less mobile than previous generations who spent their free time using their imagination and playing outside. As such, Millennials are arriving to basic training in the poorest shape ever; a direct reflection of the de-emphasis on physical fitness and nutrition, not only in civilian schools but also in modern society (Cantrall, 2010).

Current 2010 Center for Disease Control (CDC) reports state that 67 percent of adults over age 20 are overweight, with 34 percent of those considered obese; the recruits arriving at an Army reception battalion confirm these figures (Cantrall, 2010).

The cultural challenge of maintaining hardiness has plagued civilization for thousands of years, and the United States is no different. In fact, the United States, until recently, has been underprepared for every conflict that it participated in since its inception. During the American Civil War, Vegetius's concept of fighting fitness illustrated itself in General Thomas "Stonewall" Jackson's Virginia Brigade as they performed speed marches and other training maneuvers against opponents in the Shenandoah Valley. A typical day's march in January 1862, for example, carried the Stonewall Brigade 28 miles across both the Caeapon River and the western Shenandoah Mountains to seize the key communications center at Romney, Virginia. This march, which drove two other Confederate units to the edge of mutiny, was carried out in driving sleet, with 60-pound packs and no time to rest or eat (Krause, 2002). Although the Army of the Confederacy was considered by many historians to be the finest light infantry at the time, the Stonewall Brigade's fighting fitness was more of an exception that a rule for the Confederate and the Union army. In his approach to the Battle of Antietam, Lee lost 16,000 stragglers on the march-16,000 men that he desperately needed on the battlefield (Krause, 2002).

Since the U.S. was involved in conflict for a better part of half of its initial existence, the Armed Forces did not have sufficient time to develop a program design capable of simultaneously training troops and maintaining fighting fitness throughout a campaign (much of this had to do with logistics, nutrition, and other factors of the period). It was not until the late 1800s that the military first adopted formalized training, and the "Battle of the Systems" began. The Turners of Germany, the Sokols of Czechoslovakia, proponents of the Swedish Ling System, numerous Asian body-mind philosophies, and the British tradition of

sports and games brought a trans-cultural revelation to the United States (Thomas, 2002). A closer look of these systems follows in the next paragraphs.

The German Turn Verein, or German Gymnastics movement, began just after Napoleon's humiliating defeat of the Prussian army in 1806. The movement's founder, Friedrich Ludwig Jahn, born in 1778, started preaching that an independent Germany could result only through the unification of German lands, democratic reforms, and young Germans trained in vigorous physical exercise, patriotic ideals and love of liberty (Reimer, 2010). The movement used gymnastics both as a tool for achieving political goals and overall fitness as well. German freedom and strength revolved upon the youth of the state and, therefore, the supreme aim of physical education was to develop sturdy citizens possessing a love of their homeland and the aggregate strength to throw off the rule of the oppressor (Zeigler, 1973).

Sokol, developed in 1862 by Miroslav Tyrs and Jindrich Fugner, based the program on the philosophy that only physically fit, mentally alert, and culturally well-developed citizens can make a nation strong and give life to the honorable spirit of patriotism. The word "sokol" translates to falcon and is symbolic of the Sokol ideals: courage, strength, endurance, fraternalism, love of democratic principles, and pride in country (Sokol USA, 2010). Like the German Turn Verien movement, European nationalism, cultural patriotism, and the political climate of the day heavily influenced the Sokol movement. Sokols played a large role in the development of Czech nationalism by providing a forum for mass-based nationalist ideologies through lectures, discussions and group outings amongst its members.

While the German Turn Verein and the Sokol system focused mostly on developing muscular strength, Sweden's Henrich Ling's program focused his gymnastics on the harmonious development of the human body, and focused on movements leading to esthetically pleasing body positions. Despite this focus, Ling received some criticism because of his military focus and highly regimented classes. There was a tendency, some argued, to focus "too much on isolating

certain groups of muscles, to strengthen these by repetitive work in the gymnasium, and to discharge the patient with an exhortation (too often futile) to continue exercises at home (Dobbie, 1937).

Despite large immigrant populations bringing their different exercise systems to the United States in the late 1800s, the German Turn Verien movement eventually secured a strong foothold into Army training. Two primary reasons were 1) LTC Herman J. Koehler, an enthusiastic German Turn Verien participant himself, was hired the primary physical training instructor at West Point in 1885, and 2) Turn Verien training protocol had more scientifically structured training methods than other systems. Koehler was instrumental in designing a program for the West Point cadets that produced at the least a solid experience and knowledgeable physical fitness base that the cadets could take to their units upon assignment. This knowledge, combined with overall governmental reform at the turn of the 20th century, developed into a systematic fitness program for the average Soldier (Krause, 2002). However, it was not until the publication of the Army's first physical fitness manual in 1919 (FM 21–20) did an organized training concept truly take hold. Driven by the World War I expansion, the Army spent an enormous amount of time trying to shape recruits into an effective fighting force suitable for trench warfare in Europe (Krause, 2002). From WWI through the early 1970s, Army fitness was a mix of individual and unit sponsored programs. Program design was at the mercy of the current chains of command, and mixed human performance results occurred throughout Korea, Vietnam, and other conflicts. This situation opened the door to the bodybuilding and running influences that began in the 1970s.

Bodybuilding and running significantly influenced military training and changed the "Battle of the Systems" landscape completely. Until the recent THOR3 initiative and previous work done by some within the SOF community who maintained purpose built program designs, strong bodybuilding and running influences prevail throughout the military today. Though resistance training and running have been staples of a Soldier's physical preparedness since antiquity,

they were part of a holistic system designed to maintain fighting fitness for mission accomplishment, and were not an end all solution to fighting fitness by in-and-of themselves. The specialized bodybuilding and running cultures broke the holistic concept and influenced many Soldiers to stray from the required generalized training path. This phenomenon originated from many reasons, but media influence of Arnold Schwarzenegger bodybuilding exploits, coupled with the running exploits of Jim Fiix and George Sheehan were largely to blame. This influence, coupled with the fact that Soldiering perpetuates social conditions as hyper-masculinity, mastery of self (some would say narcissism), and desire to look good in uniform all play a role in the popularity and influence bodybuilding and running had on training programs (Klein, 1993). Despite the fact that all of these traits play a role in a Soldier's battlefield effectiveness, many Soldiers, as mentioned previously before in other chapters, lose focus that they are training for combat, not for the sake of a competition. This situation, however, is not necessarily the individual Soldier's fault; factors, such as human performance inexperience, influences, whims, and desires of the established chains of command, and current strength and conditioning facilities all play a role in Soldiers' training methods. Morale, Welfare, and Recreation (MWR) facilities around the military are full of machines that force people to sit while exercising and encourage the muscle isolation found in many bodybuilding programs. Cardiovascular training opportunities are limited as well; sports teams often occupy the only area available for training deceleration, quick turning movements, sprints, and other agility drills.

The concept of fighting fitness is once again coming to the forefront within the military community. With the development of the Ranger Athlete Warrior Program, THOR3, and commercial systems, such as CrossFit (Glassman, Crossfit) and Gym Jones (Twight, Gym Jones), training protocols are once again changing. Attitudes toward strength training and hypertrophy are shifting from gaining muscle for the sake of gaining muscle, but as a response to specific strength training protocols, and looks are just a by-product of task specific

training. In other words, Soldiers are reverting from to training to look better, but looking better because they train for a specific event (Boyle, 2001). The running culture is changing slowly. The long, slow run will always be a staple of a Soldier's training protocol; however, the emphasis on slow endurance is quickly changing to middle distance and sprint specific type of training as a response to current urban and rural battlefield conditions. The Army's new physical fitness Field Manual 21–20, reflects this trend as the program design focuses on the ability to start, stop, change direction, get up, get down, and any other tasks that soldiers have to perform in full spectrum operations (Cox, 2010). This variation in the new program and running to time versus running to distance has aided in reducing bodily injuries as well, something that the new millennial generation, who is inclined to lean toward strengthening exercises instead of endurance exercises, has benefited from (Knapik, 2003).

The new training programs give rise to a debate between specificity and generalization. To be a successful Soldier, it is necessary to train for general-purpose fitness; however, embedded within this concept is the need to specific training for power, strength, agility, endurance, and mental factors within the dynamic context of the operational environment. This presents an interesting dilemma for the strength, conditioning, and rehab professional when designing a program suitable to address the unique needs of the SOF Soldier. Programs, such as CrossFit, while exceptional in general-purpose fitness and its ability to provide challenging, primalistic workouts Soldiers enjoy, falls short in specific programming required to develop the fitness attributes previously mentioned. Alwyn Cosgrove, a noted strength and conditioning coach, notes that this "all over the place" programming can be dangerous:

> A recent CrossFit workout was 30 reps of snatches with 135 pounds. A snatch is an explosive exercise designed to train power development. Thirty reps is endurance. You do not use an explosive exercise to train endurance; there are more effective and safer choices. Another one was 30 muscle-ups. If you cannot do muscle-ups, do 120 pull-ups and 120 dips. It is just random; it makes no sense. Two days later the program was five sets of five

> in the push jerk with max loads. That's not looking too healthy for the shoulder joint if you just did 120 dips 48 hours ago. (Shugart, 2008)

Despite this, it is necessary to recognize that benefits exist if a program, such as CrossFit motivates Soldiers; minor tweaking is all that is required to integrate specificity into a program. Mark Twight, owner of Gym Jones, another commercial program that is based on CrossFit and popular with Soldiers, has done just that. Using work from Patrick J. O'Shea, Ed.D, Professor Emeritus of exercise and sports science at Oregon State University, and others, Twight preaches "while the specificity principle is the cornerstone of athletic training, variety or diversity in training is required to achieve the highest level of total conditioning" (Twight, 2004). For Mark, sport specific adaptations of the primary program are the rule at Gym Jones. Athletes first build a very high level of general fitness then convert fitness to sport specific movements and practice technique on top of that. The better the level of fitness they attain prior to practicing technique the more effective the technical improvements are because the athlete is not attempting to train fitness (organic) and practice technique (neurological) at the same time (Twight, 2004). Although this method is relatively safe, trainers must ensure that Soldiers are doing the basics right at all times. Improper functional movement at the embryonic stages will almost certainly guarantee improper functional skill later.

In this sense, the "Battle of the Systems" continues if one considers the competition between professional organizations and individual's attempts to gain the attention of today's "tactical athlete." As such, it is becoming more difficult for the SOF Soldier and the chain of commands to sort through marketing hype to choose a proper training system suitable to accomplish the criteria just stated. To drive the point home one more time, if the program does not enhance functional movement, adaptability, and survivability within the dynamic context of the operational environment, then the program is not suited for the SOF Soldier.

III. TRAINING METHODOLOGIES AND FACILITIES

A main reason for the inception of the THOR3 program, aside from reducing injuries, was to bring physical training in the SOF community on board with innovative training techniques utilized by elite level athletes and Police, Fire, and Rescue Teams. Army physical fitness training to this point generated from a fitness program established from the American College of Sports Medicine guidelines, and did not reflect the needs of the military. Until finalization and implementation of the THOR3 program into units and individual training programs, many SOF Soldiers will continue to face the same challenges, potential setbacks from injury, and repetitive, stale, traditionalist mind-set, training sessions and programs that have plagued the army for generations. To combat this, staff members of the U.S. Army Physical Fitness School and many SOF Soldiers interested in improving their performance have taken the personal initiative to seek out and implement new training programs into their prospective individual and unit programs. Likewise, whether for profit or honest interest, some human performance professionals have reached out to the SOF community in an effort to help improve existing programs as well. This chapter will discuss the new Army Physical Fitness program and three additional civilian programs that have influenced the SOF community today.

As stated previously, Army physical fitness testing was heavily influence by the American College of Sports Medicine. Traditional unit PT programs consisted of daily runs, and some version of callisthenic exercise did a relatively good job maintaining a resemblance of “fighting fitness.” However, advances in the human performance field and battlefield conditions demonstrate that better, more tactically oriented ways to cultivate a Soldier's potential are available. The job requirements of today's dynamic battlefield required extra considerations to account for the weight of body armor and other equipment strapped to Personal Protective Equipment (PPE). While Soldiers in previous generations carried enormous weight as they humped across Europe, Korea, and through the jungles

of Vietnam, they did so primarily without the extra burden of cumbersome PPE. Likewise, many times, but not always, they were able to ditch their extra equipment once engaged in enemy contact. With the new generation of equipment and armor reverting U.S. forces back to armored medieval warfare, long patrols and simple movement patterns, such as a low and high crawl, bounding over obstacles and climbing through windows became exceeding more difficult with 30 to 60 lbs of extra weight strapped to one's body.

With this in mind, the physical fitness programming did not reflect Soldier tasks. According to the Physical Fitness Directors Stephen Van Camp and Steve Palkoska,

> Physical training prior to the war wasn't really linked to what Soldiers had to do task performance-wise. Soldiers would get up in the morning, do PT and would not consider how it applied to the other training that they did during the rest of the training day. [The new program] looked at how to link physical training to the performance of the tasks that the Soldiers had to do, whether it was combat related tasks or tasks related to their specific (military occupational specialties). Professionals, such as police, SWAT teams, firefighters and rescue teams require a certain level of physical proficiency just to be able to perform the tasks of the job. Firefighters who cannot deploy the fire hose or go up a certain amount of stairs to rescue people or do certain tasks, are not going to be able to perform. The common core of what military people do is warrior tasks and battle drills; some of the most basic things they train for comes from basic training. Training to support the successful completion and performance of these warrior tasks and battle drills [is absolutely necessary for success]. (Gonzalez, 2010)

The new physical fitness program focuses on strength, endurance, and mobility in three phases: initial, toughening, and sustaining. During the initial phase, Soldiers are given a pamphlet by their recruiters designed to develop baseline fitness for basic training. Basic training initiates the toughening stage that introduces recruits to Army fitness foundations and fundamental movement skills. The sustaining, or last stage, technically never ends until a Soldier discharges from the military as Soldiers continue to increase or maintain their durability, resilience and overall fighting fitness throughout their careers. SOF

recruiting especially benefits from this new program as it will provide a better, more physically fit, in-service population from which to draw future operators.

Despite this, until the new program is established fully and a mental paradigm shift occurs within the conventional military that embraces new training protocols, physical fitness doctrine still remains largely irrelevant to the unique demands of the SOF community. This situation has forced SOF medical staffs to look to civilian resources for additional ideas on how to maximize SOF human performance. As this process developed, it was quickly apparent that while many civilian programs had potential, some were arguably better than others concerning program design, coaching, and preventing injuries. These issues aside, perhaps the most important factor for consideration is how well a program meshes with the SOF community's culture and mindset. Objectively, the following three programs have had an impact in the SOF community. All information provided here is found on the perspective websites or by contacting the program directors personally.

A. TRAINING METHODOLOGIES

1. Athletes Performance Institute

> Founded in 1999 by Mark Verstegen as a refuge for professional and elite athletes, Athletes' Performance (API) provides training, nutrition, and physical therapy programs seamlessly integrated under one roof by teams of specialists. From the first facility built in Tempe, Arizona, Athletes' Performance has grown to operate out of four facilities in Phoenix, Arizona; Carson, California; Gulf Breeze, Florida; and Frisco, Texas; as well as supporting various professional teams domestically and internationally. (Verstegen, 2010)

API is dedicated to maximizing Soldier performance in much the same way as the new Army Physical Fitness program. While focusing its systems on improving performance, decreasing injury potential, and motivating through

education, and applying lessons learned from working with top international athletes, the API team seeks to provide effective and sustainable training programs to the SOF community.

2. CrossFit

> CrossFit is a core strength and conditioning program that was designed to elicit as broad an adaptation response as possible. CrossFit is not a specialized fitness program but a deliberate attempt to optimize physical competence in each of ten recognized fitness domains. They are Cardiovascular and Respiratory endurance, Stamina, Strength, Flexibility, Power, Speed, Coordination, Agility, Balance, and Accuracy. The CrossFit Program was developed to enhance an individual's competency at all physical tasks. Our athletes are trained to perform successfully at multiple, diverse, and randomized physical challenges that are demanded of military and police personnel, firefighters, and many sports requiring total or complete physical prowess. CrossFit has proven effective in these arenas. (Glassman, 2002)

3. Gym Jones

> Mark Twight, an accomplished mountaineer and lifelong fitness enthusiast, established his *Gym Jones* training facility as an experiment that catered to a few friends and fellow athletes. It has since grown in notoriety as Mark's work with training movie stars and other individuals caught the public's attention. Mark, like many other human performance professionals, focuses genuine fitness that answers the question of "fit for what?" While Mark stresses the fundamentals, he admits the non-traditional program is not for the beginning fitness enthusiast. His primary program (and various hybrids thereof) is based on new research, anecdotal evidence and daily practice. It is designed to overcome stagnation and address sport specific adaptations for the power endurance and endurance sports. Mark aims to improve foundational strength, oxygen uptake and efficiency, power within specific movements and movement efficiency, recovery during and after effort, fueling for short and long-term events, and translation to practical execution. (Twight, 2003)

Though all three programs are successful with respect to their intended audiences, SOF Soldiers must first consider and then understand completely

how these programs relate to their profession before beginning their training programs. Unlike CrossFit and Gym Jones, Athlete's Performance Institute grew out of the mainstream strength and conditioning culture that worked with professional and amateur athletes who have the time and resources to dedicate themselves solely to increasing their athletic performance. Access to the professional strength and conditioning community is the differentiating factor that separates API from the CrossFit and Gym Jones. Though API has dedicated military programs in place that have flexible programming geared toward the SOF performance, they still stem from the basic principles of strength training and conditioning.

CrossFit and Gym Jones are very similar to one another, with the primary differentiation is that Gym Jones takes CrossFit's generalization concept a step further and adds specificity to training picture. Instead of using fitness to train for fitness, Mark Twight attempts to add specificity into his program design. Likewise, though both programs work with many military members, both are still very much geared toward sporting applications, and do not focus entirely on what is required of the SOF Soldier. Both programs touch on the primal instincts of the SOF community through their challenging programs; however, the core of both programs primarily centers on high intensity circuit training that, if done on a consistent basis, will lead to overreaching, overtraining, and possible rhabdomyolysis, which is a potentially dangerous condition in which muscle breakdown compromises the kidneys (McMillian, 2007).

The SOF community must remember that while these civilian programs may appeal to soldiers with their “primal” nature and mentally tough challenges, the program designs are geared toward training individuals with a completely different focus. This must be considered when implementing a program designed for maximizing the potential of a SOF Soldier in combat.

B. FACILITIES

Strength and conditioning facilities targeted toward training Soldiers share many of the same characteristics as facilities designed for training civilian athletes in private, NCAA, or professional sports. Although variables, such as budget, location and individual unit desires vary, successful facilities share common characteristics. Likewise, despite current strength and conditioning industry trends, which market modern technological equipment intent on driving business and profit, the same considerations of function, need, space, experience, flow, space and time apply as much today as they did 100 years ago when simple tools, such as sandbags, medicine balls, climbing ropes were the norm.

They key considerations to remember when designing a facility is that success is not about fancy equipment, but about facility function, and the goal of a training facility is to facilitate injury reduction and performance enhancement (Boyle, 2008). This statement, common across the strength and conditioning industry, produces an interesting paradox when it comes to training Soldiers, and in many cases, counterdicts current facility design trends. For centuries, Soldiers have trained with nothing but the weapons and equipment they carried, in large open areas suitable for maneuvers, calisthenics, and body weight exercises, and according to specific task oriented training protocols, such as marches, buddy-carries, log and rifle drills, etc. Generally, these methods have produced effective fighting forces that were capable, fit, and ready to conduct their assigned missions. In short, they used dependable and always free gravity for strength training, and supplemented it with conditioning in the form of long marches, sprints, and other agility drills, such as obstacles and rope climbs to increase functional strength and mobility. Only very recently did Soldiers have access to state of the art training facilities with specialized equipment, high-tech program designs and other tools that provide large amounts of feedback designed to enhance performance. Although one could argue that specialized equipment has created better opportunities for strength in isolation, enhanced

overall athleticism will improve more efficiently with a combination of general and specialized training protocols. Likewise, the "new" concept of functional training is, in reality, quite old and like many things in life, ideas recycle themselves throughout the years. Tools, such as kettle bells, medicine balls, rope climbs, gymnastic apparatuses, Indian clubs, etc., are very much in vogue with current Special Operations Soldiers who have discovered "new" secrets of training; many do not know that these tools have been around for years, and sometimes centuries.

Having said this, consideration of Soldier tasks is of primary concern when designing SOF specific facilities. Figure 3 clarifies SOF soldier specific tasks.

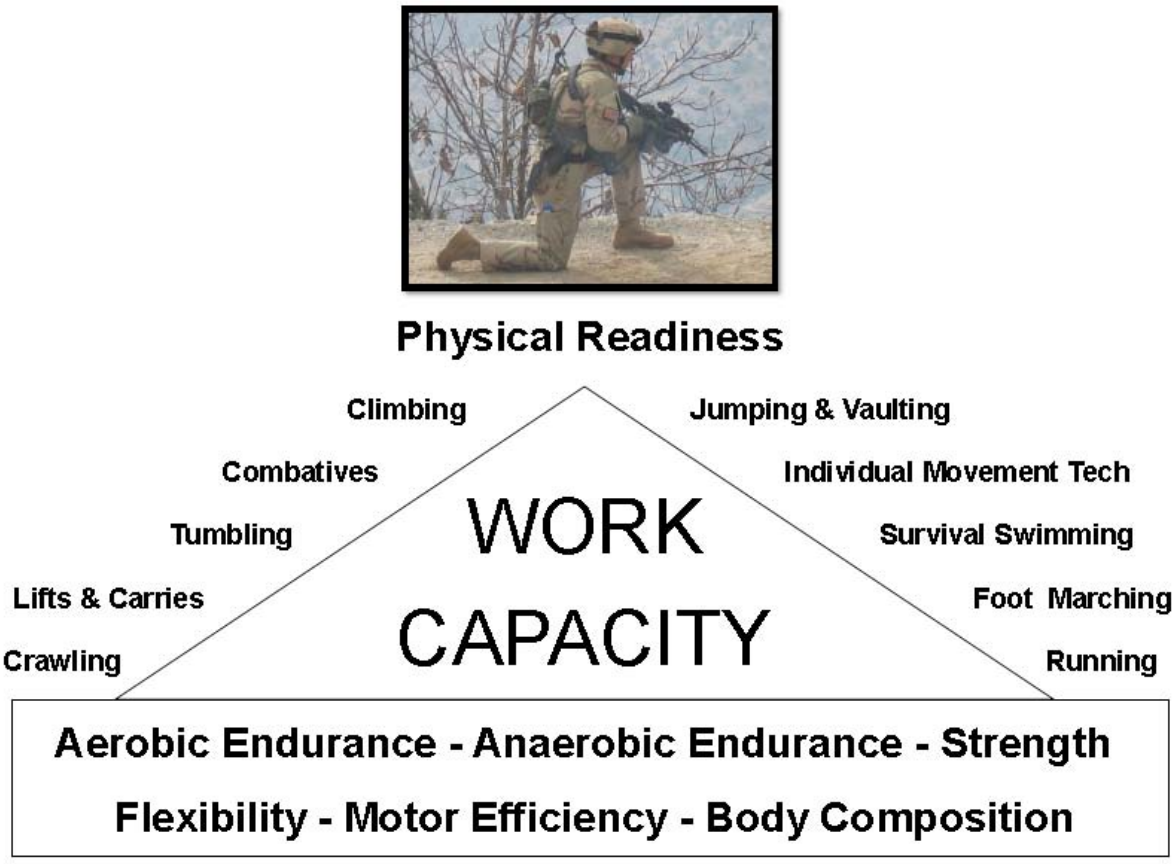

Figure 3. Work Capacity. (From: McMillian 2010)

Key points of consideration from this model are adaptation, survivability and multi-purpose use. A facility designed to address these multi-purpose events with user-friendly equipment and lots of space will act as an enabler to correct the functional paradigm, produce speed, strength, power, agility, and enhance a Soldier's mental awareness required for mission accomplishment.

Like any organization requiring buildings, space, and equipment, the strength and conditioning profession, and in turn, the U.S. military is at the whims of marketing influences. A huge number of strength coaches are not at all sufficiently knowledgeable and often rely on very poor knowledge of training science, limited methods like high intensity training (HIT), the latest machines and the best-marketed drills and toys, which have never been proved to enhance performance. Results all too often are a consequence of "something being better than nothing," the astute use of "supplements" belief, and high levels of motivation to train hard versus training smart (Siff, 2009). The point here is that officials in charge of constructing training facilities must maintain focus on the training objective and how well it will the facility will enable Soldiers to better accomplish their assigned missions.

A few basic facility construction considerations apply to all SOF unit locations. These considerations are found in the National Strength and Conditioning Association's (NSCA) *Essentials of Strength Training and Conditioning*, Michael Boyle's *Designing Strength Training Programs and Facilities,* as well as other published articles by strength and conditioning professionals. Although minor differences, such as the minimum heights of mirrors off the floors to account for athletes and Soldiers leaning weights against the walls exist in the different sources, most resources are relatively the same, and act as general guidelines for facility planning committees.

The following information is taken directly from Chapter 21 of *Essential's of Strength Training and Conditioning,* Third Edition.

The facility planning and construction process, whether building a new facility or taking over a pre-existing facility, follows a pre-design, design, construction, and pre-operation phase prior becoming fully operational. This planning process is applicable to any facility, whether it is designed as a professional human performance center with the most expensive systems, or an empty storage facility with basic training equipment. It is interesting to note that constructing a facility is very much the same as constructing a SOF Soldier, the foundation (functional movement) has to be rock solid before moving to construction and preoperational phase (functional skill).

The Pre-Design phase consists of a needs-analysis, or assessment, and a feasibility study. The needs-analysis is dependent on the unique needs of the SOF unit. It attempts to answer the following questions:

1. How many Soldiers will use the facility?
2. What types of specific strength and conditioning training does ach athletic group require (e.g., circuits, machines, free weights, Olympic lifts, plyometrics, and agility)?
3. What are the age groups of the Soldiers (in this case, Operational, Direct Support, and Support)?
4. What is the training experience of the Soldiers using the facility (novice, intermediate, or advanced). This question is possibly the most important question to ask when considering how the facility will help solve the SOF functional paradigm.
5. When will resistance training fit into each unit's schedule (morning, late afternoon, early evening?)
6. What repairs and adaptations to equipment must be made to meet the Soldier's needs (T. Baechle, 2008)?

Like any project, budget will drive facility construction. The feasibility study will address, costs, facility location, programs of interest to each unit, projected usage, and often utilized the SWOT (strength, weaknesses, opportunities, and threats) business model.

The Design phase includes the following elements:

1. The design and planning committee comprising a variety of qualified professionals is finalized.
2. The planning committee works with the architect to finalize facility blueprints.
3. Equipment specifications for allocated facility spaces are included in the project design.
4. Facility spacing is designed to be user friendly taking into consideration health codes, safety codes, legal codes, and traffic flow while maintaining an aesthetically pleasing environment.
5. The facility is designed to provide easy access to all Soldiers (e.g., both those with and those without disabilities) (T. Baechle, 2008).

Once design is complete, facility construction can begin. It involves the following tasks:

1. Construction is begun and completed.
2. The master plan must be continuously consulted to ensure that the project goals and objectives set in the pre-design phase are achieved.
3. Deadlines must be set and adhered to, or a default penalty may have to be paid by the architect or contractors.
4. The strength and conditioning professional and the planning committee should be present on the job site as often as possible during the construction phase to make sure the design features are being adhered to (T. Baechle, 2008).

Once construction is complete, the final phase prior to opening the facility is the pre-operation phase. The critical part of this phase is hiring the most qualified staff as possible, with the appropriate level of education, employment experience, and certification. Concomitant with this is a continuing education, staff development, in-service training, and advanced credentialing (T. Baechle, 2008).

Table 1. Facility Construction Checklist.

1. Facility design and construction begins with the forming of a committee of the individuals who will have a role in planning facility construction. These include, but are not limited to the head strength and conditioning director, athletic director, athletic consultants, financiers, and people who will be operating and using the facility.
2. Conduct a comprehensive program analysis to determine present and future needs; then realize that eh need for future facilities may fluctuate based on the expansion of existing activities or the creation of new ones, and determine how you will proceed.
3. Conduct a feasibility study
4. Write a comprehensive facility plan, including information concerning space needs, programming trends, existing facilities, modern facility innovation, and available equipment.
5. Write a detailed description of the services to be provided, their associated needs, and their manner of functioning. This can be extended part of the facility plan.
6. Select and hire a well-qualified planning team.
7. Write down the detailed qualitative and quantitative space requirements necessary to accommodate the proposed services.
8. Develop a well-defined and realistic project completion schedule.
9. Review carefully the architectural drawings and specifications at each stage.
10. Select and hire reputable contractors for the construction of the facility.
11. Complete the facility under the control of a well-qualified project supervisor.
12. Hire well-qualified and competent staff.
13. Formally inspect the facility, install the fixed and movable equipment, and orient the staff.
14. Occupy the facility and initiate the service-space is always a premium in a strength, conditioning, and rehab facility. Here are some considerations to abide by when designing a facility:
    a. 100 square feet per person
    b. As much ceiling height as possible
    c. Mirrors 24 inches off ground (will not break because of weights leaning against room)
    d. Don’t let architects fir out walls (i.e., do not cover walls with sheet rock. Stone walls are desirable for slamming medicine balls against them).

Table 2. Equipment.

1. 10 ft. per bar
2. No 35 lb plates (take up rack space and provide little benefit to the user)
3. Twice as many 10 lb plates as 25s, 5s and 2.5s
4. Compressed and welded dumbbells in 2.5 increments or Powerblock dumbbells (2.5 lb increments allow inexperienced or younger soldiers to “groove” a movement pattern prior to attempting heavier weight).
5. 15, 20, 35 lb Olympic bars (for the females with little or no strength training)
6. 1.25 pound plate mates (magnetic solution that allows 2.5 lb increments)
7. 1.25 pound Olympic plates (not common in many gyms, but moving from 45 lbs to 50 lbs is a 10% increase in weight. Many Soldiers will not be able to make a 5 lb progression, but will able to make a 2.5 lb progression)

IV. CASE STUDIES

The following case studies demonstrate how the SOF and civilian communities continually attempt to breach the gap between the civilian-oriented human performance industry and the Special Operations Community. These programs have gathered enough data on individual civilian athletes and SOF personnel to make accurate assessments regarding training protocols, rehabilitation techniques, and nutrition; however, the programs are by no means finished products. Instructors continue to push the envelope to enhance the SOF Soldier's adaptability, survivability, and durability as research and knowledge pushes forward into the future.

A. NATIONAL STRENGTH AND CONDITIONING ASSOCIATION'S TACTICAL STRENGTH AND CONDITIONING PROGRAM

The National Strength and Conditioning Association's (NSCA) Tactical Strength and Conditioning Program (TSAC) is accredited as the first civilian organization to make an concerted and professional attempt to create a human performance program targeted specifically for the tactical community. While other civilian programs existed prior to formation of the TSAC program, none of them had the span, depth, and width of professional research and scientific resources that the TSAC program. The Tactical Strength and Conditioning (TSAC) program was created for military personnel, law enforcement officers, and fire/rescue first responders and emphasizes the importance of injury prevention, strength, power, speed and agility. This program was designed to combine the science of applied research and the evidence of elite training to

deliver to the military, Special Forces, law enforcement, SWAT (Special Weapons and Tactics), and fire/rescue in a style that is interactive that includes Power Point and hands-on demonstrations. The TSAC program offers multiple educational opportunities, as well as specialized programs and courses (NSCA, 2010). Like the Ranger Athlete Warrior (RAW) Program, and later the Naval Special Warfare Tactical Athlete Program (TAP), TSAC is focused on developing and maintaining functional fitness, reducing non-traumatic injuries by applying knowledge of human performance and modern medicine. Understanding specialization can be detrimental to the SOF Soldier, the program ties together all aspects of strength, power, agility, speed, and recovery to enhance work capacity.

TSAC originated from a core group of NSCA veterans who were concerned about the number of injuries, antiquated training protocols, and lack of preventive medical care within the military, particularly within the SOF community. Geographic location, timing, access and placement next to 10th Special Forces Group (SFG), Airborne headquarters, as well as an understanding of the trickledown effect within the military led the NSCA to focus initially on the SOF community to ensure its training programs were packaged correctly for the intended audience. As the TSAC training protocols began to enhance the training and operational success of 10th SFG Soldiers, word started to spread throughout the SOF community, and eventually reached the highest COC levels in the Pentagon.

The NSCA TSAC program, with its vast network of top international and national researchers, coaches, and rehabilitation professionals, is highly adaptable to the needs and requirements of the SOF community. Understanding that there is no one right way to maximize a SOF Soldier's potential, the TSAC program uses all aspects of strength and conditioning knowledge to maximize SOF Soldier's human performance potential. This attitude facilitates the

exchanging of information with national and international leaders in the SOF community, as well as other civilian agencies that include firefighting, Law Enforcement, NCAA, and professional sports teams.

Despite its success, the TSAC program is still in its embryonic stages of development. With its vast amount of human performance resources at its disposal, it now stands to maximize fully the potential of its intended audiences by having the ability to drill down and answer the “fit for what” question that has plagued so many fitness programs. Interestingly, this opportunity springs from its relations with the tactical community, and the fact that fire, law enforcement, and military communities all have their specific needs and requirements. TSAC's organizational design will ensure integration with the different communities that could facilitate new and exciting human performance ideas that will drive research and application for many years. Couple this with the fact that as a non-profit organization focused solely on improving human performance without bias to specific organizations, businesses, schools, or professional teams, the NSCA's “honest broker” reputation will continue to facilitate good working relationships with its partners and clients while avoiding roadblocks typically seen in other business arrangements. This, of course, is dependent on positive results. However, as the marriage between the new THOR3 program and TSAC expertise continues to grow stronger and professional and friendly rapport solidifies (most newly hired THOR3 strength coaches are certified strength and conditioning specialists under the NSCA), the TSAC program will continue to play a vital role in enhancing the human performance of the SOF Soldier.

Currently, the TSAC program offers four distinct educational programs designed for the individual SOF Soldier and units.

1. Facilitator's Course

The Facilitator's Course is open to military, law enforcement, and fire personnel who are responsible for their unit's fitness. This course will provide basic strength and conditioning concepts that will prepare the facilitator to implement strength and conditioning programs into their unit's fitness program.

2. Coach's Course

The Coach's Course is an advanced course designed to provide cutting-edge information to tactical strength and conditioning professionals, as well as those who work directly with police, fire, and military personnel. Coaches will learn various methods to develop "operational fitness."

3. Outreach Education

The Outreach Education Program is designed to provide cutting-edge information to police, fire, and military personnel tailored specifically to a team or agency's needs. Attendees will learn various methods to develop "operational fitness" and prevent injuries.

4. Mentor Program

The Mentor Program is hosted at the NSCA World Headquarters in Colorado Springs, Colorado and goes into detailed education and hands-on training for professionals that are tasked with leading the performance program for their unit/agency or for individual tactical athlete. This program is specific to the task of the individual, as well as specific to the client in terms of their training age, injury history and performance abilities. This course is hosted for small groups or team members (NSCA, 2010).

B. RANGER ATHLETE WARRIOR PROGRAM (RAW)

The concept for the Ranger human performance initiative that eventually became “RAW” dates from the summer of 2005. At this time, the battalions had several years of experience with civilian strength and conditioning coaches, and training approaches reflected the diversity of the coach's backgrounds. Despite the fact those potential missions and the physical requirements of those missions are the same for each battalion, the instruction at the battalions varied significantly. Another more practical concern was also evident: even the most successful of the coaches could not practically serve the entire battalion. By way of comparison, a college football team might have four strength and conditioning coaches serving a much smaller element than a Ranger battalion does.

As the concept for RAW emerged, three objectives were identified.

1. Control Injuries

No one is against injury prevention measures unless they sacrifice performance. In nearly all instances, sound training practices control injuries and improve performance. For example, replacing some distance running with strength and/or movements skills training will not only decrease the likelihood of lower extremity stress injuries, but will also improve Strength/movement skill performance.

2. Improve Performance

The desire to improve performance does not suggest anything other than a fundamental philosophy of all great organizations–be better tomorrow than you are today. Fortunately, knowledge and experience allow training methods that build upon the Ranger tradition of exceptional physical performance.

3. Standardize Ranger PT

Rangers at each battalion should develop similar physical proficiencies. PT need not look exactly the same at each battalion, but physical capabilities should be more or less the same across the Regiment. With those three objectives, the Regimental Medical Section began consulting military and civilian performance experts. In January of 2006, the RAW development team began a pilot study with a platoon from 3–75. Results were encouraging enough to present the full program to the battalions, beginning in June of 2006 with 2-75. The degree to which the program was implemented varied across the Regiment. Factors, such as deficient space/equipment, op tempo, and leader preference for decentralized PT, were cited as reason why RAW was not fully implemented. The RAW development team sought to address these issues with modifications to the initial program. Version 2.0 of the Ranger Athlete Warrior Program was introduced to the battalions beginning in January of '07. Version 2.0 represented an attempt to align the program on paper with the reality on the ground. The major changes from the initial RAW guidance were:

1. The use of menus to allow greater flexibility in planning workouts facilitated:
2. More flexible scheduling guidance, with the option for battalions to follow the sample schedules provided or use general scheduling principles to create their own model.
3. Squad-leader based execution of physical training on most days.
4. Earlier use of battle-focused PT sessions.
5. Addition of field-expedient strength training options.
6. Changes to the Ground Base session to lessen time constraints.
7. Availability of the RAW Handbook on Darby/CD. The handbook provides a visual reference to enhance execution of the drills.
8. More running, with detailed guidance to avoid overuse injuries.

In January of 2008, the RAW team began training representatives from the battalions (one per company) to become subject matter experts (SMEs). The intent was for those SMEs, along with the BN physical therapists, to be the

primary resources within the BN for RAW training, scheduling, and assessments. Also in January of 2008, senior leaders approved a battery of RAW athletic and tactical assessments, such as sled carries, wall obstacles, agility testing, and rope climbs that are vastly different and more tactically applicable than the APFT. With Version 3.0, the first formal training occurred and modification of the program was based on feedback from across the Regiment and interaction with physical training professionals, both military and civilian. The major changes in RAW 3.0 were:

1. The addition of assessments that measure a broad range of physical attributes.
2. Addition of power endurance workouts using the Tabata method.
3. Updated guidance on the execution of all drills.
4. Modification of scheduling guidance.

A major objective for 3.0 and the accompanied training was to clarify the intent of the program. RAW is not a series of training events that must be followed to the letter; it is a philosophy. A fundamental tenet of the program is that Rangers are athletes. To the degree that anyone depends on their physicality for occupational success, they are an athlete and must live accordingly. Such a life requires a smart, disciplined approach to 1) physical training, 2) nutrition, 3) mental toughness, and 4) prevention and management of injuries—the four components of RAW. Leaders are charged with guiding young Rangers down this path.

Like the THOR3 program, RAW is a continual work in progress. Leaders at all levels must take the fundamentally principles of the program and make it work for their men. As the saying goes, “the devil is in the details.” It is through continual feedback that the details will get right. The RAW philosophy is found in Appendix B.

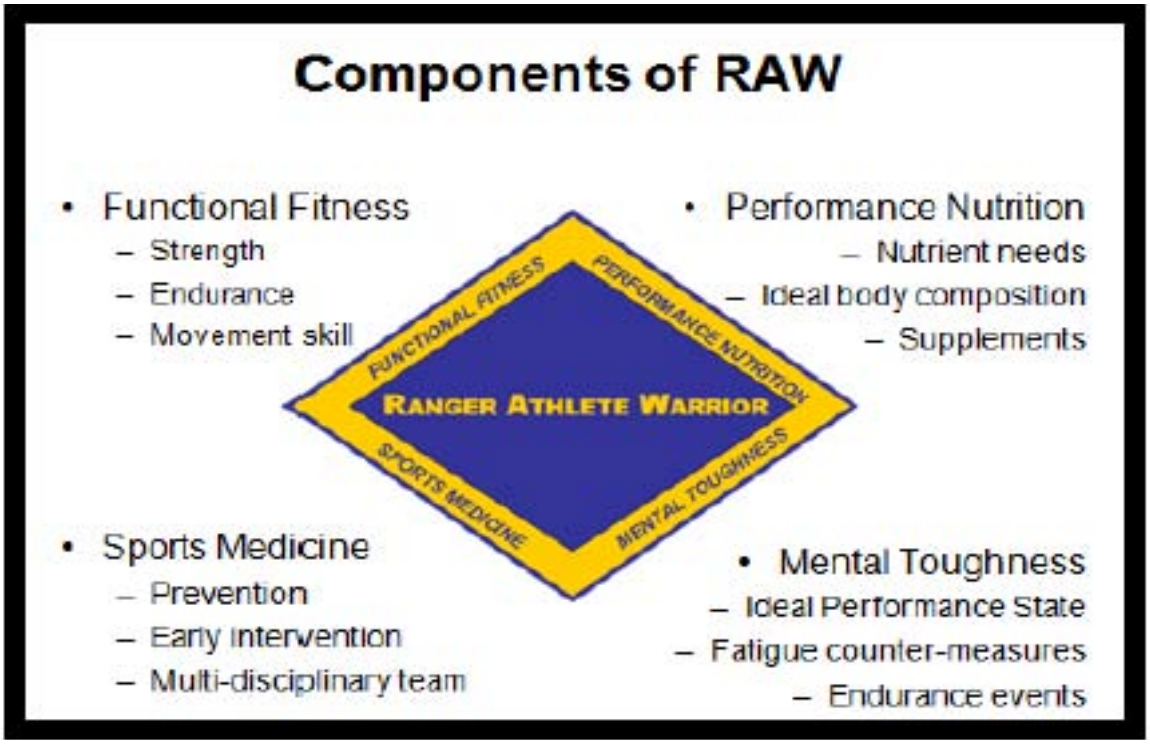

Figure 4. Components of Raw. (From: RAW 3.0)

C. DEVGRU TACTICAL ATHLETE PROGRAM

The following section contains information obtained from an interview with the staff of the Naval Special Warfare Development Group (DEVGRU) concerning the unit's Tactical Athlete Program (TAP). Personal names, information, and other confidential data were purposely omitted. This information outlines some of the challenges, changes and success that the DEVGRU implemented to increase operator efficiency, survivability, and adaptability on the battlefield.

1. Program Beginning

The Naval Special Warfare (NSW) community provided both sports medicine and human performance (then strength and conditioning) care for well over ten years, with the original push beginning in late 1990's with the integration

of orthopedic surgeons, physician assistants, and physical therapy technicians, and later Certified Athletic Trainers (ATC's) into the Special Warfare (SPECWAR) logistic and support units. The program began to see some gradual changes in injury evaluation and treatment, but minimally due to logistical constraints. Many of the ATCs in the NSW community, hired originally as civilian contractors, are full time civil service employees today. As of this writing, the current "talent pool" consists of ATC's (many of which are dual credentialed as athletic trainers and strength and conditioning specialists), NSCA certified strength and conditioning specialists, nutritionist and dieticians. The active duty component provides Physical Therapists and Physician Assistants to the staff.

2. Needs Analysis

Post 9/11, the need for a well-conditioned and fit Naval Special Warfare (NSW) operator was necessary to sustain prolonged operational capacity throughout several month deployments in climates ranging from hot / arid climates with extreme temperatures in an urban environment, to cold weather operations at altitude in the northern mountains of Afghanistan. Team medics or hospital corpsmen handled the old process of injury identification, evaluation and assessment, treatment and management, and restoration. Infrequently referrals for follow on care by more credentialed providers routinely led to injuries being treated by Rest, Ice, Compression, Elevation (RICE) and "addressing the Motrin deficiency," which led to short term fixes and ultimately exacerbation on musculoskeletal conditions that could have been minimal in nature if handled properly. The average turn around (as evaluated by Naval Medical Center—Portsmouth) for just a routine knee arthroscopy was well over 12 months from initial onset of injury, management from line medic or corpsmen, to increased injury, to referral, evaluation by credentialed provider, to specialty testing, to surgery, to post operation rehabilitation and recovery. In the professional

sports/college community, many of these type injuries are identified, managed, rehabilitated, and returned to duty in 25% of that time period (just by stream lining the process).

In 2003, this situation changed with the hiring of new staff that borrowed from existing injury management protocols in professional sports. With a new, proactive versus reactive mindset, the NSW community looked to adopt a training model similar to the National Football League (NFL) combine process and the in depth level taken to screen future players. This screening included internal and orthopedic medical issues, cognitive and socio-emotional/psychological issues, background evaluation and screening, and anthropometric and physiological evaluation/measurement. It also includes baseline performance testing and functional performance analysis.

After examining the NFL's process, the new staff implemented a new training model with modifications made to fit the needs of the military and identify specifics pertinent to SPECWAR population. Gradual implementation occurred in attempts not to disrupt operational tempo. The implementation process occurred in the following steps:

1. Design and development of process to present to command staff and overview of components.
2. Discuss timeline for staged progression of phases.
3. Show comparison to professional sports / Olympic sports / college sports models. This included a site visit to the NFL combine in Indianapolis, IN.
4. Design and identify functional testing and evaluation metrics with military specific identifiers.
5. Discussion of the new rehabilitation process and its positive effect on rehabilitation time and manpower loss. Likewise, discussion also focused on increasing operational capacity by identifying predisposing injury factors and steps taken to correct potential problems prior to injury occurrence (i.e., solving the functional paradigm), and maximizing performance through tailored, structured programs designed to progress and not to "crush" operators (versus individual programs being hashed together with no consideration for rest, etc).

The program was implemented in 2004 with the integration process of the medical screen into the command screening process. As of this writing, over 1500 medical screens have been performed on NSW SEAL operators, Special Warfare Combatant Crewmen (SWCC), and Explosives, ordinance, and demolition (EOD) personnel. Many of these medical screens have identified predisposing factors that could eventually lead to injury, or current injuries and deficiencies that high demand evolutions would exacerbate later. Upon completion of the medical screens, prevention strategies were discussed, implemented, and followed, with command sports medicine and strength and conditioning staff personnel.

In 2005, implementation of current physical readiness tests (PRT) and integration of six functional tests were integrated into the medical screening process (PRT). From 2006 to 2008, medical, PRT, and functional testing continued along with embryonic discussions for incorporation of clinical / laboratory testing occurred with the solicitation of help from Old Dominion University and the University of Pittsburgh. The process continues today with increased diversity.

3. Implementation

The military as a whole, especially the army, is reliant upon physical therapists. The community as a whole, while well versed in taking care of musculoskeletal injuries sustained sub acutely, fails to incorporate the athletic training population in the initial post injury care and management. The professional sports model utilizes a wide range of sub disciplines from the medial practitioner to the physician assistant, physical therapist, athletic trainer, and strength and conditioning specialist to evaluate, identify, and restore an injury through initial onset to return to duty status, incorporating strategies to minimize recurrence / exacerbation of injury.

The Naval SPECWAR community faced many organizational design obstacles that ranged from organizational culture to roadblocks emplaced by traditionalist thinking mindsets. The physical therapy, athletic training, and strength and conditioning community created animosity toward each other largely because each community clung to its traditional way of doing things without looking past traditionalist thinking to instead focus on what is best for the operator.

Another roadblock came from the operators themselves. Largely influenced by the media, operators had to be educated in the finer points of program design. This is an on-going issue with every new group of operators coming through the training pipeline. More and more operators are finally buying into the new Tactical Athlete Program as time goes on. This is largely in part due to the educated staff and its experience leading a population as they continue to direct personnel in proper movement techniques, program designs, and rehab methods. Through integration and strategic communication, the staff has able to convey to the operators that hard, primalistic workouts are good when timed appropriately within a structured, periodized, program with areas of muscle confusion. This, the DEVGRU staff admitted, is perhaps the greatest challenge, and something anyone training any SOF personnel will probably face in the future, especially considering that, every SOF operator considers him or herself a fitness expert. Testing and Evaluation can be found in Appendix 3.

Like any successful program design for the SOF Soldier, is to look at what is working and what is not, and modify from there. Likewise, the staff must continuously evaluate and assess metrics and determine if they are providing information relevant to the progression of the program. Initially, the staff found several metrics (9+) that gave statistical significance in determining whether an operator would be successful in the completion of the SPECWAR selection and training process. As the numbers of tested individuals increased, many of the tests started to have less significance. The cause is yet to be determined if it is increased knowledge of tests, which has led to better training and preparation, or

simply better integrated training by implemented human performance and special management staffs. Although tests are significant, they are not the sole priority. Like the NFL combine where players can test really well, but sputter throughout their careers, the main priority is to establish baseline metrics and track an operator over his career continuum, in several areas to provide information on power, endurance, strength, agility, etc.

Another interesting insight is that while SPECWAR has not noticed a significant decrease in the number of injuries sustained, there is decreased severity of the injuries and less time lost due to injuries. Likewise, data has shown that operators are able to sustain the stress and rigors placed upon them through integrated Injury prevention strategies and pre-emptive corrective exercises incorporated into workout routines to increase strength and stabilization of body regions.

As the reader can see, each program has specific fitness requirements applicable for the unit's unique missions, but overall, many of the goals were the same. The ultimate goal was to improve an SOF soldier's ability to sustain operational performance across a broad range of environments that ranged from the extremely hot and dry climates in urban environments to extreme cold in mountainous terrain and high altitudes.

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V. NUTRITION

Besides understanding and maintaining functional movement skills, applying nutritional concepts to one's diet is perhaps the hardest human performance aspect for the SOF Soldier to understand and implement. Proper nutrition forms the foundation for human performance. Too often, individuals devote considerable time and effort striving to optimize performance, only to fall short because of inadequate and sometimes harmful nutritional practices (HPSC, 2010). Reasons for this include busy training schedules, lack of desire to study the books and self educate, and food availability; though SOF Soldiers have time after duty hours to shop wisely while in the grocery store, they are at the whims of the dining facility menu during the day (if they have time to eat at all). These issues aside, changing the way a SOF Soldier operates will require changing the mindset; the old analogy that good nutrition for the body is as good fuel for a car does not resonate with all SOF Soldiers, especially those new to the SOF community. This chapter's aim is to provide a useful primer to dispel certain nutritional myths and simplify the fueling process so SOF Soldiers can make sound food choices in a time-constrained and/or inadequate food environment. This chapter will hopefully provide both a stepping-stone and spark for the SOF Soldier to continue on the path of nutritional education. As it works through different nutritional issues, it is the author's hope the literature will demonstrate that proper nutrition and fueling is not as difficult as it is believed to be, and if the SOF Soldier sticks with basic principles and concepts, that he or she will have no issue formulating a good performance diet.

The primary role of nutrition in strength and conditioning enhancement is to support and enhance mission performance. SOF Soldiers should not, and cannot focus on a diet plan not suited to their job, particularly if the diet focuses on looks alone. Though intimidating accoutrements have played a role in affecting Soldiers' psyche in the past, nowhere in documented military history has a six-pack of abs won the honor on a battlefield. Looks, as previously stated in

early chapters, are simply a by-product of a good program design intended for performance. The SOF Soldier must focus on providing him or herself with the adequate hydration, appropriate energy intake, and adequate protein, carbohydrate, fat, vitamin, and mineral intakes that facilitate maximal benefits from training (Baechle, 2008).

Navigating through nutritional information can be a daunting task for a Soldier unfamiliar with nutritional basics. Understanding nutrition basics first goes a long way to help make sense of the fueling confusion, of what and when to eat, how to fuel before, during and after exercise or operations, how to navigate through the jungle of engineered sports foods; and how to choose the best diet to enhance human performance (Clark, 2008). Learning nutritional basics is similar to learning any other military skill, deliberate and systematic study will diffuse the fueling confusion. Likewise, before putting together a proper nutrition plan or cooking a meal, a Soldier must have some rudimentary knowledge of how individual ingredients work, and perhaps more importantly, what ingredients are necessary for human performance. It is the author's opinion, that the most difficult problem with nutrition, besides time, is understanding nutrition importance, but also he or she must value it the same way they value their strength and conditioning program. Often, a simple reminder or prior planning will go a long way to instilling good habits (such as reminding a Soldier to foam roll and stretch after a workout). On a last note before diving into a deeper nutrition discussion, the SOF Soldier must know that many eating styles can equate to an adequate diet; there is no one “right” diet for all athletes. Whether from a vegan diet, a typical Western diet, or any other diet, the human body needs adequate amounts of protein, carbohydrate, fat, vitamins, minerals, and water (Baechle, 2008). Again, nutrition is a simple process that can be complicated with by other factors, such as operational tempo, food availability, and mass marketing of products.

SOF Soldiers have two primary dietary goals: eating to maximize performance and eating for optimal body composition. Two fundamental components of the diet must be present for it to succeed: 1) appropriate calorie level and 2) appropriate nutrient levels to prevent nutrient deficiency or toxicity (Baechle, 2008). Without these, the body's energy systems will not function properly. Now, a closer examination is warranted of the physiology of anaerobic and aerobic exercise, nutrients, minerals, fluids and electrolytes in influencing a SOF Soldier's performance.

A. ENERGY SYSTEMS

To work muscles hard, the right kind of muscle fuel is necessary. Muscle cells run on a high-energy compound known as adenosine triphosphate (ATP). ATP makes muscles contract, conduct nerve impulses, and promotes other cellular energy processes. Muscle Cells make ATP by combining oxygen with nutrients from food, mainly carbohydrate. Fat, used by the muscles for fuel, can be broken down only when oxygen is present. Muscle cells really prefer to burn carbohydrate, store fat, and use protein for growth and repair (Kleiner, 1998).

ATP is generated through three energy systems. The phosphagen system rebuilds ATP by supplying Creatine Phosphate (CP), and kicks in to supply energy once the working muscles use up all available oxygen during short, intense work sessions. The glycolic system provides energy for about two or three minutes of short-burst exercise at a time, and makes glucose available to the muscles through a process called glycolysis, where dissembled glycogen is turned into glucose in the muscles and, through a series of chemical reactions, ultimately converted to more ATP (Kleiner, 1998). The oxidative system helps to fuel aerobic exercise and other endurance activities through the body's natural breathing process. As oxygen rich blood pumps into tissues, two iron-containing proteins called hemoglobin and myoglobin enter into the cells and enable conversion of carbohydrates and fats to energy. A key point in energy metabolism is that the three energy systems are not simply used sequentially,

with the ATP system first, anaerobic glycolysis second, and aerobic metabolism last. All energy systems work often simultaneously, with relative contributions varying according to such factors as intensity and duration of the activity, fuel availability, exercise training, nutritional status, and the cellular environment (Dunford, 2006).

B. NUTRIENTS

Energy comes in the form of macro and micronutrients. Macronutrients, which consist of proteins, carbohydrates and lipids, are required in significant amounts in the diet. Micronutrients, by comparison, are required in relatively small amounts and come in the form of vitamins, minerals, and anti-oxidants. Proteins, consisting of carbon, hydrogen, oxygen, and nitrogen containing amino acids, are classified as high or low quality. High quality proteins supply amino acids in amounts proportionate to the body's needs, and come in the form of eggs, meat, fish, poultry, and dairy products. Low quality proteins are insufficient in one or more of the essential amino acids (grains, beans, vegetables and gelatin) (Baechle, 2008). SOF Soldiers who are vegans must consider protein quality very carefully, or risk loss of performance. A variety of plant foods is required throughout the day to ensure that a vegan obtains the correct amount of protein for maximum performance.

Carbohydrates, the body's energy source, are composed of carbon, hydrogen and oxygen. They are the prominent fuel for most athletic and SOF endeavors, especially those activities that demand sustained moderate to high-intensity activity and those that demand repeated bouts of moderate to high-intensity activity. The demand for high power output in these activities is met by reliance on carbohydrates as a predominate supplier of ATP (Dunford, 2006).

Fats are a vital part of the diet that provide taste and satisfies hunger. Taken in the correct amounts, fats are a necessary part of the SOF Soldier's diet; however, excess fat intake leads to obesity and other negative conditions. Fats have different functions of the body, most notably are that they are the major

form of stored energy in the body that provide energy during exercise, in cold environments, and during periods of starvation. They also provide insulation when cold, help transport other nutrients to the body, protect organs, and serve as structural role in cells (Duester, 2008). The SOF Soldier must be careful of the fat intake amount in the diet. Soldiers should adjust total fat intake to fit total caloric needs, and it is recommended that no more than 35% of total calories come from fat (Duester, 2008).

C. FLUIDS AND ELECTROLYTES

Despite the difficulty of locking in a proper nutrition plan, it is understood that Soldiers know the importance of hydration. What they probably do not know, however, is how specific types of hydration affect performance. Likewise, sorting through the marketing hype of sports drinks, tablets, and other hydration supplements can be just as confusing as sorting through proper food choices. Since most Soldiers know of the importance of hydration, this section will refrain from diving into detail about the adverse effects of dehydration. Instead it will discuss the pros and cons of water and other sports drinks, and when and how to use them most effectively.

Water, the most important sports drink, and is often overlooked by Soldiers when they think to grab a cold beverage before, during, and after heavy exercise. Water is the most abundant nutrient in the human body, and is the medium for all energy reactions in the body take place. It carries nutrients throughout the body and transports waste products away. It is part of the joint's lubricant fluid and acts like a radiator for the body during hot and cold temperatures. Nearly all the available foods contain water. Most fruits and vegetables are 75 to 90 percent water, while meat contains roughly 50 to 70 percent water. Beverages, such as juice, milk and other sports drinks, are more than 85 percent water (Kleiner, 1998).

Water and sport drinks both have their place in human performance, the important issue is when to use one or the other. For exercising lasting one hour or less, water is still the best sports drink around. Sports drinks, which usually come in a mix of water, carbohydrates, and electrolytes, are the normal solution for exercise sessions lasting longer than an hour. Sports drinks pay off for longer exercise bouts because these drinks decrease the use of muscle and liver glycogen stores, which in turn, enable Soldiers to sustain activities for a longer period of time (Kleiner, 1998).

This chapter will now turn to fueling considerations of food choice, and choosing the right nutritional guidelines to enhance SOF specific activities. As a gentle reminder to the reader, there is no uniform, right way to fuel that fits all Soldiers. The same considerations for individual diversity that apply while designing a strength and conditioning program also apply while designing a sound nutritional program. Since many SOF Soldiers do not have immediate access to registered dieticians, they can follow the following common nutritional principles to help them make correct food choices. Common principles can be found in Appendix E.

Sticking with these and other proven principles will enable SOF Soldiers to avoid the pitfalls of the latest popular diets fads and crash dieting that inhibits human performance. Fad diets, often targeted toward the public with weight loss solely in mind, do not mix with SOF human performance requirements. Weight loss will give an initial performance improvement; however, it will be short lived if there is a drastic reduction in food intake. Lowered food intake also predisposes Soldiers to multiple micronutrient deficiencies that can lower performance and increase injury (Benardot, 2006). Crash dieting normally involves a massive reduction in calories, usually around 800 or fewer a day, with drastic consequences, such as the following.

- Muscle and fluid losses, along with fat loss. If 20 pounds were lost in 20 days, the first six to 10 pounds would be fluid, the rest, fat and muscle.
- Loss of aerobic power. The body's capacity to take in and process oxygen, or VO2 max, will decline significantly.
- Loss of strength. That is a major handicap if you need strength and power for competition.
- Metabolic slowdown. Crash dieting slows your metabolic rate down to a crawl. Metabolic rate refers to the speed at which your body processes the food you eat into energy and bodily structures (Kleiner, 1998).

The second consideration concerns nutritional guidelines for SOF specific activities. This consideration can be tough considering that SOF activities run the entire spectrum of fitness from very high intensity to endurance to precision skill requirements. Like a sports car designed with power and weight requirements in mind, a Soldier must have enough weight to adequately carry the engine, but not go overboard with too much body mass to hinder performance. One idea is that the SOF community should consider a nutrition plan geared toward weight and body-focused sports, but still provide enough energy for training and recovery. These sports, which include wrestling, martial arts, and gymnastics, require a true integration of mental and physical skills and demand high degrees of strength, flexibility, speed, agility, explosiveness, and concentration similar to SOF activities. Likewise, they also require plyometric strength and power, flexible hip and shoulder joints, agility, endurance, and mental stamina (Dunford, 2006). The focus here is not the sports, it is the critical idea of keeping one's weight to a level that ensures maximum performance. Testing has shown, that on average, the best weight for SOF Soldier is between 165 and 195 lbs. This weight range allows for a good mix of strength, endurance, agility, and power that facilitates general-purpose Soldier skills. Soldiers over or under this weight should not participate in dangerous weight cutting practices or attempt to quickly gain a large amount of weight for the sake of being in this weight zone; human performance and nutritional status may become too compromised. A more pertinent recommendation is for Soldiers to

find an ideal weight that allows them to operate to their maximum potential, and then try to sustain that weight by consuming the right amounts and types of food to sustain their weight and health. This way, the fueling plan focuses on maintaining a comfortable weight and performance instead of strictly body composition (Dunford, 2006). Concomitant with this and stated previously, optimal weight does not mean having a six-pack of abs. Using the three-day Best Ranger competition as an example, the 75th Ranger Regiment staff determined that Soldiers with body fat levels less than 10% run the risk of bonking because of the lack of available energy reserves. Recent Best Ranger winners normally averaged 10 to 15% body fat during the last few competitions. This military adventure race, which requires Soldiers to move long distances and complete tasks that tax all energy systems of the body, does not favor the fitness specialist, but rather those who have exceptional general-purpose fitness. A similar experience occurred in the Naval SPECWAR units when the human performance staff conducted analysis on calorie expenditure during multiple, back to back operations. These operations, which occurred over the course of two to three days and sometimes beyond, demonstrated that, on average, Navy SEALs burned 1800 calories per operation, and optimal performance levels were maintained by having body fat stores similar to the winners of the Best Ranger Competition.

If all else fails, and the SOF Soldier is completely stumped with no nutritional help to turn to, the SOF Soldier needs to refer back to the basic questions of “What am I training for?” and “How do I fuel myself for it?” Wearing boots, body armor, and carrying heavy packs and ammunition for over 60 minutes, fast roping or dragging a wounded comrade to safety, extended water operations, altitude operations, prolonged shivering in austere environments, such as mountainous regions or diving in cold water will require nutritional countermeasures to avoid complete exhaustion and muscular fatigue (Duester, 2008). Soldiers continuing the repetitive and stale nutritional practices will do

nothing to improve human performance, or keep the body in check to fight off disease and injury. This will come back to haunt the SOF Soldier after many years of physical and mental stress if not corrected.

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VI. PERFORMANCE ENHANCING DRUGS

Throughout history, athletes and soldiers have used performance-enhancing drugs (PEDs) and dietary supplements to increase human performance, decrease injury rates, and sustain minds and bodies over the long-term of a career. Despite the Anabolic Steroids Control Act of 1990, many athletes and military personnel continue to use steroids and other performance enhancing drugs (PEDs), particularly, those that required a predominant amount of strength and power to be successful. A tremendous amount of research is available about PED use in sport; however, little published information is available concerning PED use in military operations. Certain PEDs, especially testosterone supplementation, if properly administered under supervised medical care and used in conjunction with a sound strength, conditioning, and nutritional program, are a mission enabler for Special Operations Forces (SOF) personnel. Proper supplementation will prevent the loss of testosterone levels, combat the effects of cumulative injuries, and maintain optimal human performance capabilities necessary for SOF personnel to conduct their job in their highest capability. This paper, through an objective analysis of historical and modern PED use in athletic and military endeavors, will aim to demonstrate that PED supplementation (especially testosterone) is necessary not only for SOF human performance and sustainability, but also provides another necessary force protection measure critical for the safety of SOF personnel while operating in overseas contingency environments. Testosterone therapy, (i.e., anabolic steroid supplementation) for SOF personnel will help retard the adverse effects of aging. To be perfectly clear, this paper does not recommend increasing testosterone levels in perfectly healthy males over the measured, normal rates of an individual SOF soldier. It argues for supplementation for any SOF operator with low testosterone levels that result from natural aging or medical issues, such as an injury that require a relatively rapid, post immobilization hypertrophy.

To begin this discussion, it is necessary to provide a brief timeline illustrating snapshots of PEDs use in both sport and military use. PED use has occurred since the time of the ancient Greeks, dating before the informal age of Greek Athletics (before 776 B.C.) (Robinson, 1927). Most, if not all of the athletes that competed in the games (Achilles, Diomedes, Hector, and other military leaders at Troy), were responsible for the homeland defense of the Greek City states, and likely used performance enhancers during their military operations as well. During this time, the drug of choice was a viscous opium juice appropriately named “doop,” which is the origin of the Dutch word “doping” (Robinson, 1927). Like modern athletes and warriors, the ancient Olympic champions were professionals who competed for huge cash prizes, as well as olive wreaths. With the exception of game fixing, most forms of modern cheating was perfectly acceptable during this time, although PEDs somewhat differed from today’s chemically developed concoctions. There is evidence that they gorged themselves on meat -- not a normal dietary staple of the Greeks -- and experimented with herbal medications in an effort to enhance their performances. The ancient Greek athletes also drank wine potions, used hallucinogens and ate animal hearts or testicles in search of potency” (Jenkins, 2007). Fast forward to circa 100 A.D. and the time of the Roman Games, and there is ample examples of PED use in individual combat and amongst the Roman Legions. Chariot racing and individual gladiatorial combat was hugely popular during this time; horses were fed substances, such as hydromel (an alcoholic beverage made from honey) to make them run faster and gladiators ingest hallucinogens and stimulants, such as strychnine to stave off fatigue and injury and to improve the intensity of their fights (Aziz, 2006). Likewise, drug use was rampant throughout Rome, and considered and integral part of food, cosmetics, and perfumes. Three drugs, opos, libanotos, and glechon, were well-known plant derivatives and were used as painkillers and contraceptive. Honey, milk, pepper, and parts of animals and insects were used in medical treatment as well (Scarborough, 1996).

Looking to modern times, the ineffectiveness of the DA .38 Long Colt against Muslim Moro extremists in the Philippine-American war clearly demonstrated the effectiveness of PED use. The Moros, high off the native opium prior to engaging in combat, were able to sustain multiple wounds from the smaller caliber pistols issued to U.S. forces. This situation later led to the development of the .45 caliber 1911 handgun. A young American woman living in this region and a wife of an officer commented on this as she penned the following in a letter home,

"Last December a Moro attacked a captain, who fired six .38 caliber shots into him. The Moro didn't stop running for a second; he cut right on, cutting the captain to pieces with his bolo and started his way rejoicing, when a guard finally finished him with a .45 caliber bullet" (Smythe, 1962).

Recently, amphetamine use amongst Air Force and Naval pilots to help ward off fatigue during long flights have headlined growing concerns of side effects, as well as extreme aggression displayed by some soldiers as they return home from overseas contingency operations (Knickerbocker, 2002).

Besides historical use, it is also prudent to provide a quick overview of the types of PEDs commonly available and used by military personnel and athletes today. The common PEDs come in two types: 1) hormones and the drugs that mimic their effects and 2) dietary supplements. (Essentials of Strength Training and Conditioning, 2008) By far, the most common hormone is anabolic steroids, the synthetic derivatives of the male-sex hormone, testosterone (Bhasin, 1996). The physiological changes that occur from testosterone use, such as increased muscle mass, strength, and athletic performance, make it the drug of choice for strength and power athletes; however, it is a poor ergogenic aid due to its rapid degradation without chemical modifications (Wilson, 1988). The second common hormone is Human Growth Hormone (HGH). Secreted from the anterior pituitary gland, it is anabolic due to its stimulation of bone and skeletal muscle growth, but is also has important metabolic functions, such as maintaining blood glucose levels, increasing the uptake of glucose and amino acids into muscle cells and

stimulating the release of fatty acids from the fat cells (Hesse, 1989). The third common hormone used by athletes is Erythropoietin (EPO). Produced in the kidneys and stimulates the production of new red blood cells, extra EPO provides a tremendous advantage for endurance athletes by increasing the available oxygen supply (Schwandt, 1991). The final common hormones are B-blockers, commonly used by those who require steady, controlled movements, such as shooters, archers and professional musicians (Hoffman, 2002).

Besides hormones, dietary supplements are another common PED. Normally safe for consumption, the dietary supplement industry has ballooned into a multi-billion dollar enterprise. Unfortunately, unscrupulous companies lace many of the supposedly safe dietary supplements with illegal substances; this situation has caused many coaches, athletes and military personnel to exercise extreme caution prior to purchasing the dietary supplements. Common supplements include essential amino acids, which can augment muscle growth, as well as L-carnitine, responsible for the transport of fatty acids from the cytosol into mitochondria for energy oxidation (Kerner, 2000). Creatine, a nitrogenous organic compound synthesized naturally in the body, is another commonly used supplement for strength gains and quick, post workout recovery. Finally, stimulants, such as caffeine, are used to reduce fatigue, and increase alertness.

Now that a brief history and different types of PEDs are complete, it is time to tackle the issue of PED supplementation and SOF personnel. To discuss this issue properly, close examination of several factors that include social constructs and constraints, injury sustainment and prevention, testosterone loss, side effects, and SOF operational tempo and environmental complexity is necessary to make a wise judgment as to whether supplementation should occur.

To begin, the first question to answer is simply why some PEDs are licit and others are not? Originating in Germany in the 1920s, the modern issue of illegal PED use began when doctors conducted experimentation on athletes for the first time in an attempt to improve human performance. According to Dr. John Hoberman, professor at the University of Texas,

> Condemnation of doping on ethical grounds appeared during the 1920s as sport became a genuine-mass cultural phenomenon. The ground of international sporting events…created a new arena for nationalistic competition that served the interests of various governments. Larger financial investments and the prominence of sport in the emerging mass media gave elite athletes a new social and political significance, which helped foster new suspicions about the competitive practices of others. Having left its age of innocence behind, sports medicine embarked on a new experimental phase involving the collaboration of trainers, physicians and pharmaceutical industry. At the same time, a new international sports establishment arose championing an ideal of sportsmanship that was threatened by the use of drugs. (Hoberman, 1995)

Dr. Otto Riessur, director of the Pharmacological Institute at the University of Breslau, commented on the ethical conundrum of PED use in sport in the early 1930s, when he stated,

> I don't know whether that sort of thing has been tried…but all of us feel a healthy inner resistance to such experiments, such as artificially boosting athletic performance, and, perhaps, a not unjustifiable fear that any pharmacological intervention, no matter how small, may cause a disturbance in the healthy organism….in difficult cases, common sense and conscience must be the final judges. (Hoberman, 1995)

The moral and ethical difficulty, Professor Hoberman states, stems from the identification problem of what are licit and illicit techniques of drug use. This conflict, inevitable in a society that both legitimizes and distrusts pharmacological solutions to human problems, developed into the culturally conservative response and "pharmacological Calvinism" approach that took approximately a generation to develop, and gradually manifested itself into the contradiction seen today (Hoberman, 1995). This Calvinistic approach; however, is increasingly under scrutiny as the enormous market that feeds the desire to improve the human organism continues to grow. PEDs and their various forms are used every day to deal with work related stress, lack of sleep, and to maintain overall alertness. Smart drugs, none of which have been proven in a scientifically valid trial, are sold to promote "cognitive enhancement," while stress-reduction

devices, biofeedback machines and somatrons (which bombard the body with musical vibrations) also used in an attempt to affect brain waves to increase intelligence, boost memory, strengthen the immune system, and combat phobias (Hoberman, 1995).

Concomitant with this contradiction is the dilemma of whether to apply the same rules of sport and society to the military. On one hand, some say the military is a reflection of society its members swear an oath to protect. Likewise, as much as possibly, the Laws of Land Warfare, Geneva Convention, North-Atlantic Treaty Organization (NATO), and Rules of Engagement (ROE) attempt to mitigate and civilize the death, destruction and mayhem that ensue in the combative environment. However, are these respected notions truly incompatible PEDs for military use if the drugs are prescribed in a professional and safe manner under the watchful eye of properly trained health care provider? Again, the contradiction is clearly seen if one considers other types of "performance enhancers" given to SOF personnel that range from prescribed medications, hearing aids, eye-enhancement surgery, medical care, clothing and gear, and other forms of readily available technology. Soldiers train to win their nations wars and come home safely. SOF operations are conducted in an ambiguous environment against an enemy that does not follow the same rules, regulations, or preventions found within the framework of international law and NATO. The SOF "game" is not about fairness, but about winning, period.

Injury care and prevention is another topic that requires consideration in the PED argument. The operational tempo of SOF units continues to increase, operations are lasting longer, pilots are required to fly farther, and the injury rates since 9/11 are increasing. A recent 2008 Cohort Study aimed to identify the diagnoses that resulted in most medical evacuations from overseas contingency operations found that non-battle related injuries, particularly musculoskeletal and connective tissue disorders continue to be the leading cause of medical evacuation in modern warfare. The study reported that of the 34,006 evacuated personnel, 8,104 (24%) suffered musculoskeletal and connective tissue

disorders, 4,713 (14%) sustained combat injuries, 3,502 (10%) suffered neurological disorders, 3108 (9%) suffered psychiatric diagnosis, and 2,445 (7%) suffered spinal pain. (Cowen, 2008). Minus the combat injuries, most, if not possibly all, of these issues are preventable or curable prior to deployment through a sound training protocol of strength, conditioning, rehabilitation, and nutrition, clinical and proper supplementation. Likewise, the frequency of deployments are such that the "off-season" for SOF units is filled with other tasks, which prevent operators from conducting proper training necessary to regain adequate strength, conditioning, and rehab prior to pre-mission training. This conundrum has existed for many years, and like any other performance driven profession, some SOF soldiers to turn to PED use to keep up with job demands. Like professional athletes, SOF injuries can be the difference between "playing" for another year's salary or forced early retirement due to the inability to perform the required duties. Unlike professional athletes who suffer nothing more than a lost game or penalty if having a bad day, the potential for having a bad day in the SOF community could be the difference between life and death. There is no doubt that SOF units are ready to deploy when the time comes, but the predominant concern is the quality of physical and mental readiness. Napolean quoted long ago that strategy is the best use of time and space and that the time is never right. Considering that there is no off-season for SOF personnel; with the exception of a few cases since 9/11, the time has never been perfectly "right" for SOF forces to establish a training regimen long enough to ensure personnel have enough time to successful complete a thorough training and rehabilitation cycle. Slotting the "player" back into a starting position prior to reaching the required level of operational readiness puts long-term benefits at risk for short-term gains, and could drastically cut the SOF soldier's career short in the long-term as well when considering the cumulative effect of injuries over time. This issue is common in amateur and professional sports where athletes turn to PEDs to enhance performance, work through or quickly recover from injuries, while also trying to maintain body mass, strength and power throughout

long seasons (recent major league home run sluggers, multiple scandals in professional cycling, as well a numerous instances in Olympic competition clearly demonstrate this). SOF Soldiers are susceptible to the same perceptions of PED effectiveness that professional players are, and often time misconstrue the lack of scientifical data with safety. Problems arise when SOF personnel gain second or third hand information about certain PED efficacy and side effects, and perhaps most importantly, continue use despite known harmful side effects. A discussion later in this chapter will demonstrate that testosterone supplementation, if administered properly, is a safe and effective method of increasing strength and gaining lean body mass without harmful side effects. The discussion will also show that HGH, EPO, and B-blocker use clearly demonstrate harmful and potentially deadly side effects with usage as well.

Similar to injuries, the effects of aging are a big concern for SOF personnel as the strength, endurance, agility, and reflexes slowly degrade over time. Regardless of a complete training protocol, the effects of aging are unstoppable, and as stated previously, injuries are cumulative. Testosterone loss also comes with age, and can have a detrimental impact on many male human performance characteristics, such as increased fatigue, increased irritability or depression, reduced muscle strength and mass, inability to concentrate, decreased bone density and osteoporosis (www.menshealthnetwork.org, 2002). Testosterone therapy, (i.e., anabolic steroid supplementation) for SOF personnel will help retard the adverse effects of aging. To reiterate from the opening paragraph of this chapter, this recommendation does not say to increase testosterone levels in perfectly healthy males over the measured, normal rates of an individual SOF soldier. A testosterone supplementation program is intended to maintain normal testosterone levels in older populations to prevent the previously stated adverse effects of low testosterone levels. Although individual testosterone levels vary and careful consideration of different dose levels will require diligent oversight, there is plenty of data demonstrating the feasibility of a testosterone

supplementation program. Studies demonstrate that there is an apparent dose-response link to the effects. A 2005 meta-analysis in middle-aged men demonstrated that testosterone replacement produced significant increases in lean body mass, but only sporadic increases in muscular strength (Isidori, 2005). Friedl et al. examined androgen administration of (a) 100 to 300 mg per week of testosterone enanthate or (b) 300 mg per week of nandrolone for six weeks in physically active men. Again, dose-relationships demonstrated where the largest gains in body weight and isokinetic muscle strength were seen in most cases with 300 mg wk of testosterone enanthate (Friedl, 1991). With other over-the-counter supplementation forms and a sound training protocol, there is simply no need to for a higher testosterone dose than necessary.

As far as HGH, EPO, and B-blockers helpful affects are concerned, each substance has demonstrated certain performance characteristics that are potentially beneficial for the SOF Soldier. However, these benefits, such as gains in lean muscle mass (HGH), the ability to enhance endurance by increasing aerobic capacity (EPO), and ability to reduce anxiety and tremors during performance (B-blockers), are offset by the severity of the harmful side effects discussed further in the reading.

It is pertinent now to speak of potential side effects resulting from using PEDs. It is also important to note that most PED side effects stem from abuse of individuals self-administering high dosages, and not from proper medical supervision (Essentials of Strength Training and Conditioning, 2008). In a groundbreaking study conducted by Dr. Shelander Bhasin of Boston University School of Medicine, 43 men were given injections of 600 mg of testosterone enthanate or placebo for a 10-week period, and were broken down into four groups: placebo with no exercise, testosterone with no exercise, placebo with exercise, and testosterone with exercise (Bhasin, 1996). The results of this study were not surprising, as the men who received steroid injections gained fat free muscle mass and overall strength. There were a few things unique about this study was that unlike previous studies done in the past. First, this was the first

PED study done in a controlled environment with the correct research design that took into account protein and energy, had a standardized exercise stimulus, and no competitive athletes whose motivation to win kept them from staying within the standardized testing rules (Bhasin, 1996). The other unique factor of this test was that it debunked the myth that anabolic steroids were harmful over the short-term (which explains why athletes "stack" multiple types of androgens in cycles). The only reported side effects from this 10-week study were three cases of acne and two cases of breast tenderness. Likewise, no differences in mood or behavior were reported from any of the groups in the five sub-categories of anger assessed by the Multidimensional Anger Inventory, which measures frequency, duration, and magnitude, mode of expression, hostile outlook, and range of anger-eliciting situations (Bhasin, 1996).

Other PEDs have greater side effects than testosterone if not administered correctly. EPO injection increases the risk of blood clotting, elevations in systolic blood pressure, and a compromised thermoregulatory system. B-blocker studies have shown that B-blockers impair the cardiovascular response to exercise by reducing oxygen and substrate delivery to exercising muscles, light-headiness, increased fatigue, and hypoglycemia in type 2 diabetics. Increased body mass is a Creatine-supplementation side effect, and can be advantageous for SOF soldiers trying to put on lean muscle mass and get stronger (Essentials of Strength Training and Conditioning, 2008). Although normally a welcome effect for certain members of the SOF community whose job is to lift heavy equipment and operate in an environment that requires deliberately methodical movement, extra body mass is detrimental for SOF Soldiers who normally operate in a cockpit or who are required to move adequate distances over undulating terrain with heavy loads.

In conclusion and to restate this paper's thesis, some PED supplementation is necessary to mitigate the adverse effects of aging, fatigue, injuries, and the cumulative wear and tear from a high operational tempo in SOF units. Testosterone therapy, (i.e., anabolic steroid supplementation) for SOF

personnel will help retard the adverse effects of aging. To drive the point home for the reader one last time, this chapter does not recommend testosterone supplementation for perfectly healthy males over the measured, normal rates of an individual SOF soldier. It argues for supplementation for any SOF operator with low testosterone levels that result from natural aging or medical issues that require a relatively rapid, post immobilization hypertrophy. Research has demonstrated that certain PEDs, particularly testosterone, can be administered safely and effectively with minimal side effects under proper medical supervision and measured dosages. There is an important note to consider with PED supplementation, and that is just that, supplementation. SOF Soldiers must not forget that enhancing and maintaining diminishing performance levels in the aging operator is not possible with PEDs alone. PED supplementation is part of the entire human performance system that includes a sound nutritional program, proper strength, conditioning and mental training protocols, as well as ample time given for recovery as allowed by the operational tempo.

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VII. REST AND RECOVERY

This chapter intends to make a few brief comments about an often-overlooked aspect of human performance: rest and recovery. Soldiers and athletes spend most of their time worrying about getting stronger, faster, and powerful, but often fail to realize the simple fact that muscle growth and power improvement does not happen during training, but during the rest periods. Failure to adapt to training stressors, either physical or psychological, can lead to detrimental conditions common to many athletes, such as overtraining, overuse or burnout. Work alone is not enough to produce the best results; a Soldier also needs time to adapt to training. A simple formula for SOF Soldiers to remember the importance of recovery is:

Work Hard and Smart + Recovery Well = Best Performance

The principle of recovery refers to that part of training where the benefits of the work undertaken are maximized through practices that reduce residual fatigue and enable the athlete to cope with workloads more effectively. This enhances the athlete's capacity to undertake more work, as well as their capacity to work more efficiently, which in turn, encourages better adaptation to training (Calder, 2005). Rest and recovery are critical to accelerate a return to baseline from the stresses and effects of frequent, high intensity operational tempo deployments. Rest and recovery also play a vital role to counter repeated high intensity training sessions (Cook, 2010).

A. CATEGORIES

The recovery process generally breaks down into two broad mental and physical categories. Mental categories include sleep and forms of psychological/emotional care, such as soothing music, motivational literature, or

quiet time away from daily stresses. Physical recovery can involve tissue work in the form of massage, stretching, and hydrotherapy treatments, as well as relative rest, or light activity.

Sleep is the most critical part of recovery, and is the most violated aspect by the SOF community (the amount of caffeine consumption is a clear indicator). Though individuals vary, the general rule of thumb is that a good seven to nine hour of sleep every night is required to facilitate proper recovery and rest. Too much sleep, too little sleep or long naps can inhibit the body's ability to adapt to the stresses of training. Deep sleep will encourage the release of hormones for recovery of muscles, tendons and ligaments, as well as the immune system. Lighter sleep stages will help to reinforce neural patterns stimulated during training sessions. Drugs, alcohol, environmental changes, delayed bed times and illness can all disrupt normal sleeping patterns and recovery (Rogers, 2009). Specific information on the types of fatigue that Soldiers are susceptible to is included at the end of this chapter.

Nutrition is just as important in the rest and recovery phase as it is in training. Fuel and fluid replacement is critically important to replenish energy stores for the future training sessions. For more on sound nutritional practices and strategies, please refer to the nutrition chapter in this thesis.

Warming down, stretching, and massage is just as important as a dynamic warm-up, and is skipped often by Soldiers struggling to fit their workouts into a time-constrained environment. Understanding that needs vary from individual to individual, a recommended, post workout recovery method is to foam roll for five minutes and then static stretch for five to ten minutes as well. Foam rolling, or the “poor man's massage,” relieves the muscle density (knots) caused by injury, overuse, and going cold after a workout. Stretching, of course, adds length and increases flexibility.

Hydrotherapy in the form of hot/cold contrast water immersion, or general movement in an available swimming pool is an effective way to stimulate the nervous system, increase blood flow that aids in removing lactic acid, and in general speeds the healing process from hard workouts. Ten to fifteen minutes in a swimming pool of movement consisting of large general movements of the body can relax, refresh and speed the process of recovery. Three to four minute hot tub alternated with a 30 to 60 second cold plunge repeated for three reps can greatly foster the recovery process. For relaxation, end with a warm environment, which will encourage sleep. For recovery between training sessions, end with a cold bout. The cold tub should not exceed 10 degrees Celsius (Rogers, 2009). More hydrotherapy protocols are provided at the end of this chapter.

Psychological means of recovery include common methods of listening to music, meditation, progressive muscle relaxation (PRT), breathing techniques, imagery and visualization. Two uncommon techniques that Soldiers may not be aware of include REST (Restricted Environment Stimulation Therapy), and autogenic training. REST places a Soldier in a water-filled tank that represents weightlessness with no sight and sound. Autogenic training is a specific muscle relaxation technique that focuses on warm and heavy sensations that indicate relaxed state and are useful to focus after stressful situations (Calder, 2005).

The final recovery enhancement techniques are simply coping mechanisms designed to help the emotional stress of deployments, unforeseen circumstances, and or other events that occur during normal causes of the workday. Spending time with fellow Soldiers, telling jokes, watching movies, and reading are all coping mechanisms to deal with stress.

An example of spa and plunge protocols is found in Appendix D.

B. TYPES OF FATIGUE

1. Metabolic Fatigue

Metabolic fatigue is volume related, such as training for over an hour in length, multiple training sessions, as well as the overall cumulative effect of fatigue and can be recovered by the use of re-hydration and refueling immediately after training and competition. Metabolic fatigue can be recognized by early onset of fatigue, normal training seems more difficult or the athlete struggles to complete the session.

2. Neural Fatigue of the Peripheral Nervous System

This is also volume related and caused by high intensity sessions or long low to moderate sessions of training and can be recovered by adequate rest between training sessions, hydrotherapy, light active and static stretching, as well as massage. Low power output, heavy/slow feet and poor technique are symptoms of neural fatigue.

3. Neural Fatigue of the Central Nervous System

Neural fatigue is caused by low blood glucose levels brought on by high pressure training sessions involving rapid decisions and reactions or just training monotony. This type of neural fatigue is expressed by lack of motivation/passion and can be recovered by steady intake of carbohydrate during and after training, rest and alternative activities, such as music, movies and video games.

4. Psychological Fatigue

Team conflict, competitive pressures or other outside stressors, such as school and personal or social conflicts cause psychological fatigue. This type of fatigue is expressed by loss of confidence and/or lowered self-esteem; poor

interaction and communication among team members; negative attitudes; increased anxiety and poor sleep patterns. Activities that include reading, movies, books, and video games help to remove this type of fatigue.

5. Environmental and Travel Fatigue

Disruption of normal routines, such as sleep patterns, meal timing, increased sitting or standing requirements, cultural changes, climatic differences and time change cause environmental and travel fatigue. This fatigue is expressed normally with longer warm-up needs and slower starts to the workout, increased unforced errors in early competition and earlier onset of fatigue. Recovery strategies for this type of fatigue include proper preparation and planning for training and travel: adequate hydration and refueling patterns; limiting climate stressors, such as extreme heat or cold; minimize visual fatigue with sunglasses and limited computer time and minimizing hearing fatigue by wearing ear plugs on long flights and limiting loud music on MP3 players (Rogers, 2009).

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VIII. REHABILITATION

It is time to shift gears for a few moments and discuss rehabilitation. Discussion to this point focused on preventing, maintaining, and enhancing SOF Soldier human performance and correcting the functional movement deficiencies. The rehabilitation bottom line for the reader is simply this: rehabilitation is a waste of time if the Soldier cuts corners during rehabilitation process, and returns to duty less than 100% with uncorrected movement deficiencies or dysfunctions. Achieving results in rehabilitation is no different from achieving results in strength and conditioning programs optimal results will not be achieved without putting the nose to the grindstone and working through the whole program. Haphazardly working though a rehab process will almost guarantee the development and reinforcement of new, subconscious movement deficiencies as the body goes through the healing process. Likewise, stressed multiple times throughout this thesis, the importance of fixing the functional paradigm elevates to a greater importance during the rehabilitation process after an injury. Solving an injured Soldier's functional paradigm is a more laborious and difficult as injuries can exacerbate existing movement deficiencies and dysfunctions that occurred prior to an injury. Likewise, injuries and pain, more than factors of fatigue, hunger, or lack of sleep, cause the body to move in awkward, unbalanced movements that force Soldiers to work against the natural movement patterns of the human body. Within this difficult process, however, lies a unique opportunity for rehab specialists and Soldiers to slow down and ensure a solid functional movement foundation is built throughout the rehab process. Correct rehabilitation has a process similar to executing strength and conditioning program, the process should have purpose, precision, and progression that accelerate practical achievements, not just difficult activities. Likewise, active communication among the physical therapist, strength and conditioning coach, and the chains of command are necessary to ensure that Soldiers complete all the steps of the rehabilitation process in the correct manner, which is what the best professionals,

educators and researchers stress repeatedly: *Fundamentals always come first* (Cook, 2010). If fundamentals and steps along the rehabilitation process are compromised, the risk of re-injuring or shortening the operational lifespan of the SOF Soldier is elevated. This chapter's goal is to provide a brief overview of injuries and the functional rehabilitation process, discuss some common mistakes made during this process, and provide insight on critical functional rehabilitation methods necessary to ensure SOF Soldiers return to duty with little chance of re-injury.

Injuries are classified in two categories: macrotrauma or microtrauma. Macrotrauma results from a specific, sudden episode of overload injury to a given tissue, and results in disrupted tissue integrity. Contusions, fractures, dislocations, subluxation (partial displacement of the joint surfaces), and sprains fall into this category. Microtrauma occurs as an overuse injury resulting from repeated, abnormal stress applied to a tissue by continuous training or training with too little recovery time (Baechle, 2008). Overuse injuries may be due to training errors in program design, suboptimal training surfaces (too hard or uneven), faulty biomechanics or technique during performance, insufficient motor control, decreased flexibility, or skeletal malalignment and predisposition (Giladi, 1991). Common microtrauma injuries are stress fractures and tendinitis.

Movement deficiency and dysfunction, if not existing prior to injury, normally occurs as the body begins the healing process as pain and injury cause subconscious, instinctive changes in movement compensation patterns. Movement deficiency and dysfunction is rarely a singular event or has a single cause in any given person (Cook, 2010). Closely related to the “straw that broke the camel's back” idea, it is sometimes difficult to pinpoint the exact time, location and cause of an injury, especially considering that work in the SOF community puts Soldiers into contorting positions within vehicles, buildings, and other structures while carrying 50 to 60 lbs of kit strapped to their bodies. These positions could possibly aggravate or exacerbate an injury previously sustained in other activities that did not show during a physical examination, but could

possibly show up in a functional movement screen. Different movement screens exist that help physical therapists and other rehabilitation specialists determine if a Soldier has a movement dysfunction or deficiency. Despite the differences, most of them measure balance, control, functional mobility (mobility specific to the training and demands of the activity), function of the lower control zone (pelvic stability, central zone (trunk stability) and upper control zone (scapular stability) (Elphinston, 2008).

Physical therapists classify movement deficiencies and dysfunctions into three categories: *Developmental, Traumatic,* and *Acquired.* Developmental movement problems arise when movement opportunities are denied or modified, or inappropriate activities are introduced in an otherwise normal system (Cook, 2010). This is rampant in children's sports, especially when overzealous parents and the pressure to perform at an early age places unnecessary stress on growing joints and muscles by overtraining without first ensuring that a sound, fundamental base is first established before moving to higher level movement skills. If the issues are uncorrected as the child continues to grow, then the lack of functional movement carries into adulthood. These issues are the cause for many reoccurring injuries that many Soldiers face during their careers.

Traumatic movement dysfunction is just that, any movement dysfunction or deficiency caused by trauma. Since pain is normally present with trauma, and the body naturally moves in a different way to compensate for the pain, movement dysfunction is normally accessed easily through proper movement screening. The challenge for therapists occurs when the new, naturally developed movement compensations and patterns for pain remain in place after an injury is healed. Though the new movement patterns are good for a short-term solution, they create unnecessary stress on joints and muscles over the long term if not corrected after an injury heals. Immediate return to an exercise program will not fix the situation; that will only reinforce the bad habits. These habits cure through proper training and an outside source; an outside source is required because most habits are at the subconscious level and take a trained

physical therapist to identify correctly. Likewise, the use of pain killers that artificially reduce or cover up pain allow injured Soldiers to move into patterns that would be instinctively avoided when injured (Cook, 2010). In this situation, Soldiers make the mistake to use pain as the indicator of how far the healing process has progressed. Though playing with pain and mental toughness is necessary to being a successful SOF Soldier, there is a limit to this mantra. Pain is the body's natural way to protect an injured site by preventing moving patterns that will exacerbate the injury further. The use of painkillers, while recommended and useful, allow Soldiers to continue movement patterns normally not conducted without them. Though this is sometimes necessary during the course of operations, Soldiers must be aware, especially with traumatic injuries, painkillers cause a shifting of natural alignment and stabilizing reactions occur as normal reflexes to support movement when moving into or around painful patterns. Even when synthetic means cover the pain, motor control, reflex stabilization and reaction times are less than authentic (Cook, 2010). Even though absence of pain is a sure sign of recovery progress, it is not a sign of complete recovery. A Soldier cannot be completely sure if rehabilitation is complete by using pain as the only indicator. In the past, once the pain was gone, it was the green light to resume training if they could move without pain. Many re-injure themselves in the same location later on, sometimes very quickly. Physical Therapists and other rehabilitation professionals have realized for some time 100% complete return from injury is unknown without a proper movement screen that takes the isolated measures of strength, power, explosiveness, balance, or agility and applies them in a holistic functional test to determine if movement patterns are completely re-acquisitioned.

Acquired dysfunction generates in two ways. The first way is through unnatural activity repeated on a natural movement base, and the second way is natural activity repeated on an unnatural movement base (Cook, 2010). Soldiers are susceptible to both of these situations. The first situation occurs when activities require special skills, training or movement against a natural movement

pattern (Cook, 2010). This description seems penned specifically for the SOF community. It is only a wonder that more injuries occur when considering the weight bearing requirements of a Soldier's basic load, weapons systems, and any other equipment hanging on personal protective equipment (PPE), contorted positions and joint stress from sitting in cramped vehicles and insertion platforms, as well as the austere operating environments. Exacerbating this situation even more is Soldiers' continual exposure to these situations during training cycles and deployments cycles through different frequencies, operational intensities and short and long durations. The best method to counteract these situations is simply being proactive and focusing on symmetrical exercises designed to ensure the body stays in balance. Specific training often does not facilitate bilateral movement patterns that promote asymmetry. Despite this, unilateral awareness and correctional foresight goes a long way to helping Soldiers maintain peak physical and injury free fitness.

The second situation that facilitates acquired dysfunction, which is natural activity on an unnatural movement base, result from activities that appear natural and within functional limits. Unlike the first situation, in this case, pre-existing movement dysfunctions and asymmetries cause Soldiers to compensate on basic tasks (Cook, 2010). Like the first situation, many SOF Soldiers fall into this category as well, possibly more so than the first. Soldiers working to lose weight, start a rigorous training program for assessment or deployments, training, or assessment, without first obtaining a movement screen are all susceptible to this situation. The key point here is not the activity that is hurting the Soldiers; it is the incorrect movement patterns and deficiencies in place prior to starting their programs. The increased volume and intensity of training exacerbates existing deficiencies and can sometimes do far worse to groove inefficient patterns into the subconscious levels that if the Soldiers were on an easier program.

After obtaining a functional movement baseline from an initial movement screen, rehabilitation can begin. The process for injury rehabilitation is different from rehabilitating movement deficiencies or dysfunctions. For injuries,

rehabilitation is a three-phase process that consists of an inflammation phase, repair phase, and remodeling phase. The timing of events during these phases differs for each tissue type and is affected by a variety of systemic and local factors that include age, lifestyle, degree of injury and the damaged structure (Baechle, 2008). The inflammation phase is the body's initial reaction to injury and the beginning of the healing process. Normally lasting two to three days following an acute injury, it may last longer if blood supply is limited, and severe structural damage is present (Baechle, 2008). Edema (bruising), which is the escape of fluid into the surrounding tissues, normally occurs during this phase, and the primary reason that limits an athlete's function, and potentially causes movement dysfunction.

The second rehabilitation phase is the repair phase. Repair cannot start until completion of the inflammation phase, and can last for two months. During this phase, new capillaries and connective tissue, called collagen, form at the injury site, and act as a foundation for tissue repair during the remodeling phase. During this phase, Collagen fibers are emplaced somewhat haphazardly, and are not aligned with the injury's lines of stress (Baechle, 2008).

Remodeling occurs during the final phase. Collagen fibers enlarge, harden and begin to align themselves with lines of stress to finish the healing process and allow a Soldier to return to function. Something to consider at this point is that while the strength of the Collagen fibers increases tremendously during the remodeling phase of healing, the new tissue will likely never be as strong as the tissue it has replaced (Baechle, 2008).

Successful rehabilitation of movement dysfunctions or deficiencies is largely influenced by the SOF Soldier's personal desire, dedication, focus, and willingness to diligently work on correcting the problem. A screen and assessment create a two-pronged suggestion. They suggest corrective strategy that are dysfunctional and not painful, and identify and allow continued activities in movement patterns not compromised by pain or dysfunction (Cook, 2010). This will require the SOF Soldier to put the desire for primal workouts aside for a

short time to allow ample enough time to rebuild any dysfunctional patterns through corrective exercises. These exercises do not require supplemental work, and are designed to target weak links and biomarkers that establish reduce risk and higher performance (Cook, 2010). Patience is required for the SOF Soldier in this process. Dysfunctional movement patterns do not occur overnight; they will not be corrected overnight either.

One thing to keep in mind for the SOF Soldier as he or she continues on the path of correction is that all the work and dedication applied to fixing a movement dysfunction will be wasted if one reverts back to the same training protocols or activities that produced the problem in the first place. Ben Franklin's quote, “An ounce of prevention is worth a pound of cure” is common in the rehabilitation profession; however, it is rarely abided by in the SOF community, especially when sometimes unsound, high intensity, primal workouts are the sole focus of program design.

With a brief outline of injuries and the rehabilitation process now complete, focus can now turn to the concept of functional rehabilitation, and the importance of ensuring Soldiers are able to execute 100% functional movement prior to returning to duty. In the past, rehabilitation protocols used performance tests, such as strength measurements, endurance events, sprints, agility and other commonly known activities to gauge whether a Soldier was ready to return to duty. These tests often did more harm than good; in fact, using the tests as a measure of rehabilitation contributed to the reoccurring injury conundrum that plagued the physical therapy profession for so long. A major problem was that these performance tests objectively gathered baseline quantitative information that failed to evaluate the efficiency with which people perform certain movements. Using the sit-up event in the standard Army Physical Fitness Test (APFT) as an example, a Soldier with an above average score on the sit-up test, but with poor quality and efficiency, compensates by initiating the movement with the upper body and cervical spine instead of the trunk. The test is concerned about the score only; it does not concern itself with possible microtrauma being

inflicted through improper movement (Cook, 2010). A second problem with performance tests is that they do not measure structural or functional instability, loss of motion, functional rigidity, or other factors that indicate that the Soldier is not ready to return to duty. Deficiency in any of these areas can lead to insufficient control of momentum, poor balance, coordination, timing, and overall lack of understanding of movement, something extremely important for Soldiers operating in both urban and rural environments. Likewise, deficits in strength, coordination, balance, stability, and perception will lead Soldiers to *compensate,* or unconsciously try to accomplish their movement objective even if their methods are not biomechanically ideal. Continued utilization of bad movement techniques alters stress ratios on the joints and other body structures, resulting in overuse and sometimes-traumatic injuries (Elphinston, 2008).

Along the lines just mentioned, despite an understanding of functional movement by rehabilitation professionals, there is standardization problem that plagues the rehabilitation community, and has had a potentially bad effect on the SOF community. Medical specialists define functional movement from many different perspectives that span multiple different specialties. Surgeons, physicians, and physical therapists, despite understanding basic anatomy and physiology, all look at movement from their perspective viewpoints instead of a comprehensive, multi-dimensional movement baseline. What this specialization does in a nutshell, is put an anatomy map before a movement map; forward progress cannot be made without a screen or appraisal of the current state of movement that precedes an appraisal of physical fitness or performance (Cook, 2010). Stated previously, very often, physical fitness assessments and performance tests are placed ahead of movement screens during the initial assessment; aggressive physical training cannot change fundamental mobility and stability problems at an effective rate without also introducing a degree of compensation and increased risk of injury (Brushoj, 2008). This is essentially putting the cart before the horse, and has proven wrong many times before when injury recurrence occurs.

There are many reasons for this, one of which is a Soldier's desire to return to duty too soon. Medications, usually in the form of Motrin, Ibuprofen, or other over the counter painkillers, are used to manage the symptoms associated with musculoskeletal injury, disease, ailment and pain, but do little to ensure the Soldier heals the proper way. Infrequently referrals for follow on care by more credentialed providers is a largely to blame for this; injuries treated by Rest, Ice, Compression, Elevation (RICE) and “addressing the Motrin deficiency,” which lead to short term fixes and ultimately exacerbation on musculoskeletal conditions that could have been minimal in nature if handled properly. Most often, the quick fix becomes the quick solution to the problem, and the Soldier is returned to duty with injury symptoms in place (Cook, 2010). Organizational design is partly to blame for this, as small numbers and under qualified rehab staffs, in an effort to keep pace with high operational tempo, forced the head physical therapist to hand a patients over to a less experienced staff member without maintaining direct supervision from time of injury to return to duty.

Concomitantly, the absence of an effective bridge program had a detrimental effect on the rehabilitation process. There is a difference, sometimes significant, between rehabilitating a Soldier back to functional capacity versus the capacity to return to duty. A good bridge program, besides giving Soldiers quick access to care and facilitating communication between COC and the rehab staff with updates on injury status and projecting return to duty dates, will give Soldiers guidance and direction on how to continue preparation to return to duty once discharged from physical therapy. Up to this point, Soldiers who completed their physical therapy appointments, simply rejoined their units and returned to duty while often not fully 100% healed. The THOR3 program will hopefully fix this solution by integrating the strength and conditioning coaches with the physical therapists, doctors, physician's assistants, and athletic trainers (if available). The most important point to note during the initial weeks following injury/surgery is that the strength and conditioning coach should have little

involvement until the athletic trainer or physician has determined that the athlete can begin rehabilitation. Once rehabilitation specialist allows a controlled exercise program, the strength coach may take a more proactive role by:

- Helping the patient continue key exercises performed in the PT clinic (i.e., standing resisted straight leg raises with band, proprioceptive training, cone walking, retro treadmill (to assist in knee extension), cone walking for gait, step-ups, lateral step-ups, jump rope (typically around week ten), slide board, figure eights, gentle loops, core work). At this point, the strength coach should talk to the PT to see what he has been doing and gather information on any specific movement patterns he should avoid/include with the athlete.
- Gradually progressing to low-level plyometric training drills in a straight plane and sport-specific drills (add lateral movements around week 16).
- Incorporating open chain strengthening as tolerated.
- Always asking the athlete if an action hurts. (This is a yes or no question. If they say yes and it isn't a typical "muscle soreness" pain, then refrain from performing that particular exercise.)
- Setting a goal to return to the sport at six months provided that other six-month goals have been met:
    - Full range of motion has returned
    - Joint doesn't "give out"
    - Pivot shift is symmetrical
    - Lachman's test is within one grade of contra lateral knee
    - Functional tests are at least 90 percent of opposite leg
    - Other scores/tests the PT/physician may use have been taken (Reed, 2010).

Lastly, the bridge program is effective in negating unsolicited unit peer pressure or COC influence to return to duty prior to being 100% fully recovered.

To close, Soldiers must remember that rehabilitation is a process that is unwise to cheat. One does not become swift, fast, or strong over night, nor does one heal in a day. Perceived short-term gains from cutting short or not fully executing the functional rehab process will negate long-term benefits later down a Soldier's career or after discharge from the military. Likewise, while "playing

with pain" is a necessary part of being a SOF Soldier, operating with injury is unwise for multiple reasons previously stated. If injured, Soldiers must put forth the same amount of energy, passion and study into the rehabilitation process as they do in their training, it will give the body the best chance to return to duty at 100% capability with minimal chance of re-injury. The greatest impact a Soldier can have on the rehabilitation process deals with proper lifestyle choices. Soldiers do not have the same opportunities available to professional athletes who spend hours a day in rehabilitation with no additional duties. As such, Soldiers must do everything they can to give their body the best chance to heal properly at its own rate and back to 100 percent. Through proper nutrition, rest, stretching, strengthening and other means, the Soldier will greatly enhance his or her chances of returning to duty without risking injury re-occurrence.

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IX. COGNITIVE, NEUROLOGICAL, AND EMOTIONAL TRAINING

In the beginning was the deed…Faust.

Many SOF Soldiers who consider themselves physical fitness experts by simply passing rigorous selection standards like to skip past the *crawl* and *walk* movement stages, and start at a full sprint without developing the proper fundamentals. Solving the functional paradigm requires a SOF Soldier to return to the crawl stage, re-examine current knowledge, or in some cases, drop long-used training ideas altogether. Though mentally not an easy thing to do for many SOF Soldiers, returning to the crawl stage is necessary to prevent negative movement deficiencies or dysfunctions from reinforcing potentially damaging movement patterns. This can be a difficult task for the human performance staff when dealing with an environment that rewards those who can execute high-level functional skill movements, and often times chastises those who cannot perform up to task without first figuring out why. Regardless, understanding proper functional movement techniques is critical once the environmental complexity rises; soldiers can mentally process certain amounts of information and having sound movement fundamentals leaves one less item out of the equation to worry about.

High operational tempo, peer pressure, and unit culture often times reinforce the wrong way to do things. Reinforcement of the wrong, over time, then becomes the right, which eventually leads to powerful internal mechanisms of territorialism, of distrust toward those and things that are different, and of selfishness, that precludes the open hand of generosity that has new and innovative ideas. Unit members' thought processes construct perceptions with references to previous actions; unfortunately, this leaves the brain with a propensity for retreating into pre-established schemas that it then projects onto the world and onto others (Berthoz, 2000). This situation heightens the environmental complexity for solving the functional paradigm. The limits of

human performance education, knowledge, and experience of many SOF Soldiers generate difficulty while coping directly with the confusing reality of the physical and mental training environment. Reinforcing functional movement will give the SOF Soldier a mental and physical environmental coping mechanism at the conscious, and as more experience is obtained, subconscious level.

Considering warfare is the most dynamic, taxing and complex activity known to humankind, a quick statement about the human mind is needed:

> The brain is, above all, a biological organism designed for survival and moving quickly while anticipating. Most essential properties of human thought and sensibility are dynamic processes, ever changing, ever adapting relationships among the brain, the body, and the environment. Thought and sensibility are nothing more than states of cerebral activity induced by certain relationships among the physical world, the body, the hormonal and neuronal brain, and its memory of thousands of years of culture. The most refined cognitive abilities of the brain are a product of the need to execute difficult tasks [stemming from early man's attempts to survive]. The species that passed the test of natural selection are those that figured out how shave off a few milliseconds in capturing prey and anticipating the actions of predators, those who brains were able to simulate the elements of the environment and choose the best way home, those able to memorize great quantities of information from past experience and use them in the heat of action. (Berthoz, 2000)

In order to deal with environmental complexity, the mind forms simplified, structured beliefs about the nature of the world. One theory holds that in order to simplify reality, individuals filter their perceptions through clusters of beliefs, or "cognitive maps" of different parts of the environment. The beliefs that make up these maps provide the individual with a relatively coherent way of organizing and making sense out of what would otherwise be a confusing array of signals picked up by the senses (Kam, 2004). With regards to physical human performance, functional movement is akin to the simplified, structured beliefs that enable a SOF Soldier to manuever in the complex environment. If not previously exposed to the concept of functional movement, the SOF Soldier operates with pre-established schemas of knowledge. Pre-established schemas are usually

accommodated by high and deep emotions when discussing the “right” way to train; these emotions form perceptual prototypes, or in common terms, prejudices. Perceptual prototypes and pre-established schemas projected onto any new program design becomes anticipation; anticipation becomes a prison for perception and a trap for action where the serene path of reason is abandoned for that of the emotions (Berthoz, 2000).

So how does a SOF Soldier prevent him or herself from falling into this trap? Conceptually it is easy; however, the actual application is difficult because this situation is ultimately a control issue, and everyone knows that SOF Soldiers like to be in control. Preserving personal, established prerogatives is the centerpiece of psychological reactance theory, developed by psychologist Jack Brehm. According to the theory, whenever free choice is limited or threatened, the need to retain our freedoms makes us desire them significantly more than previously. In other words, when something interferes with our prior access to some item or idea, people will react against the interference by wanting and trying to possess the item or idea more than before (Cialdini, 1984). Brehm's theory, used often by business marketers and compliance strategists, applies well to SOF Soldiers being newly exposed to the functional paradigm concept, especially considering that they worked so hard to acquire the patches, accoutrements, access and placement that define them as being special and elite. SOF Soldier must be mentally willing to return to a time before their SOF selection, and rid themselves of any pre-established prerogatives, notions, biases, limitations or screens that prevent learning. This idea is not new by any means. Miyamoto Musashi, the famous Japanese swordsman and Samurai, spoke of this in his writings in the *Book of Five Rings* over 400 years ago, “The warrior understands that the end result of any study is a kind of death (sublime, not necessarily physical) before attaining perfection” (Kaufman, 1994).

Cognitively approaching the functional paradigm without pre-established prerogatives will enable SOF Soldiers to obtain an intuitive understanding and awareness of movement prior to applying specific training techniques.

Awareness includes knowing how and where movement initiates, a feeling of differentiation and organization amongst the joints, muscles and tendons, as well as an understanding of how not to impinge one's own movement. Effective and efficient Individual movement must be in accordance with one's own personal anatomical alignment, and Newton's laws of the universe. Though somewhat philosophical, consider Newton's first law of motion: every object will remain in motion unless acted upon by an outside force. With reference to the functional paradigm, the outside force is this case is individual Soldier's incorrect execution of movement patterns. If done correctly with no dysfunctions or deficiencies, human movement is effortless; however, it only becomes effortless when all systems, organs, and six senses are working harmoniously.

Normally only five senses are considered, however, when the five senses of touch, taste, sight, smell, and hearing collaborate with other sensors, such as skin, perception, and mental awareness, kinesthesia, the sixth sense of movement, comes to play. Kinesthesia's characteristic feature is that it makes use of many receptors used for stretch and force in our muscles, for rotation in our joints, for pressure and friction in our skin, and the five receptors in the inner ear that specifically detect movements of the head (the utricle, the saccule, and the three semicircular canals). Medical professionals seem to be stuck in Aristotle's assertion: "In the psychology we have given a general account of the objects corresponding to the particular sense-organs, to wit, color, sound, smell, flavor, and touch" (Ross, 2008). Omitted often because it resides at the subconscious level, kinesthesia is the result of a collective cooperation among several sensors that coherently enable the brain to reconstruct movement in the body and environment. Inconsideration of kinesthesia, however, leads to faulty program design that disregards important human performance variables of sense of movement, space, balance, effort, self, decision, responsibility, initiative, and so on (Berthoz, 2000). Although it would benefit Soldiers to know and understand specific anatomy of the inner ear, inertia, physics, receptor sensitivity, and how the endolymph fluid of the species specific geometric

semicircular canals transmits forces of inertia to the sensory cells of the canal, operational and time constraints does not always allow this level of instruction (Spells, 1963). Despite this, a conceptual understanding of the aforementioned subjects will enhance both the THOR3 staff's ability to teach functional movement concepts by facilitating better dialogue between coach and Soldier, and open a gateway for the Soldier that provides a cognitive path to higher-level operational performance. This will enable Soldiers to think and understand movement patterns in the most precise manner possible, but also have the ability to apply the movement concepts into a larger, integrated system of higher-level SOF specific skill requirements. In other words, SOF Soldiers will be able to see both the forest and the trees.

Solving the functional paradigm is the first step to preparing a Soldier's mind and the muscle to successful employ martial skills. Again, if the SOF Soldier's mental schema or foundational movement skill training is not sound prior to deployment, then movement patterns will become inefficient and ultimately fail the individual Soldier once the environmental complexity increases. Considering again that a cognitive understanding of the basics ultimately wins the fight, it is imperative to drill functional movement into a Soldier's subconsciousness before moving to functional performance and skill (Figure 1). Again, the question becomes *how*?

First, critical for the SOF Soldier to understand that SOF specific movement patterns are conceptually no different from life's everyday movement patterns; the *application* is what differs. Understanding this idea puts the SOF Soldier in the proper training frame of mind. No matter the action, when anatomical alignment is correct, and a SOF Soldier utilizes inertia, rotation, and gravity according to Newton's laws as stated previously, movement is effortless. Agility ladder drills are an example. The hip rotation required to complete multiple drills through the agility ladder is the same rotation applied while moving up stairs while clearing a building on an objective, or working against an attacker in a multi-opponent combative situation. Historical records indicate simplicity and

the “Keep it Simple, Stupid” mantra is often the best course of action in combat. For whatever reason human beings like to forget this and complicate simple movement concepts only to be forgotten and “rediscovered” by the next generation of human performance specialists. Musashi also commented on this when he stated,

> Your fighting stance is your everyday stance, and your everyday stance is your fighting stance. Combat is an aspect of your everyday life if you follow the path of the warrior. Walking is walking, whether in an excursion to the park or in a combat maneuver. When you attack right foot forward or when you attack left foot forward, the idea is to move the body and not just the feet. The incorrect way of moving the feet will eventually trip you up and make you lose your balance. This is bad for the warrior, as it causes a loss of poise. (Kaufman, 1994)

This idea, if understood and applied, will provide a subconscious mental schema that will remain in place when the operational environment increases in complexity. Like the athletic population, some SOF Soldiers exhibit high-level performance in practice, but demonstrate performance decline when placed within the context of a highly stressful environment. In this case, though motor skills and mental representations are both inherited and learned prior to game time, the performer’s use of them alters under pressure and under emotional/mental and temporal pressure (Tenenbaum, 2009). Furthermore, some state that if a Soldier with all cognitive and motor systems established exhibits excellent performance under neutral conditions, but collapses under pressure, then the performer’s access to these systems under pressure is impaired. Reoccurring battlefield blunders indicate that it is not entirely possible to prevent this collapse. It is the author's opinion that much of this simply has to do with experience and good judgment. As the old saying goes, “Good judgment comes from experience, and experience comes from bad judgment.” However, considering that the SOF Soldier's situation is different from that of an athlete blundering in a big game, or a mishap at work, it is necessary to look beyond this simple mantra. A unified, conceptual framework stemming from THOR3 staff

and SOF Soldier interaction, which incorporates consideration of the emotional processes (i.e., feelings, mood), cognitive processes and structures (knowledge architecture, long-term working memory), motor-processes (coordination, endurance), and the neurophysiologic basis of these structural components (i.e., activation of cortical areas) will provide a working solution to preventing future blunders (Tenenbaum, 2009). A unified, conceptual framework is a direct result of *effective teaching and cognitive understanding of functional movement basics.* Again, a major variable of this interaction is open-mindedness, focus, and willingness to learn *without* preconceived notions. Sharing between instructor and student will integrate cognitive, neuroscience and movement science within a functionally accurate and precise movement framework that can apply the same movement principles to combat, physical fitness or any other SOF specific endeavor.

The second consideration is execution. Preached repeatedly in any sporting profession, this should not be anything new to the SOF Soldier. When applied to the tactical arena, cognitive understanding of functional movement will provide the foundation to stand upon when the cumulative effects of battling an adversary is bigger, faster, stronger, more powerful and agile, or resilient begin to take their toll.

Executing correctly bears reconsidering anatomical versus functional science. While soldiers tirelessly work on improving athleticism by conducting endless agility, running, and jumping patterns, they reinforce dysfunctions and deficiencies without fully understanding how to initiate the movement, or the actual forces and biomechanics behind the movement. A main problem is that the central objective of many fitness and conditioning programs has been to focus on the development of the superficial muscles trained as prime movers, assuming these muscles play a more important role in performance than the supporting stabilizing muscles. Stabilizing muscles are the smaller, deeper muscles close to the bones and joints that enhance the efficiency and power of the prime movers by creating resistance, stability and support of movement at

one movable segment, and allowing freedom of movement at another (in other words, a dynamic system) (Cook, 2010). Likewise, the nervous system, which complements the different muscle characteristics using the phasic and tonic systems, is left out of many training protocols. The phasic system, associated with prime movers, controls explosive and robust movement patterns, whereas, the tonic system is dedicated to postural control and maintenance of alignment and integrity throughout the skeletal system. The key note to remember here is that the tonic system supports the body's structure and provides appropriate stabilization for prime movers to function efficiently (Cook, 2010). This is critical to understanding movement because muscles not only act as movers, but they also have proprioceptive roles as well, as they provide feedback for the brain and the senses, especially kinesthesia. An internal awareness built upon proper use of the senses during the initial training phases, or after injury will greatly enhance a Soldier's ability to solve the functional paradigm.

Without sounding trite, a simple way for SOF Soldiers to do this is to simply slow down. A common mistake in many program designs is sacrificing accuracy or correct technique, for speed. Soldiers, anxious to develop strength and power necessary for mission completion, sacrifice the time to groove the neuromuscular patterns necessary for proper technique. This will situation will normally correct itself after a functional movement screen (discussed later on this thesis). For now, an example of combat marksmanship will be used to better illustrate this idea. As the old saying, “Speed is fine, Accuracy is final” goes, so does the performance of the SOF Operator on the range and in combat (Jordan, 1965). Similar to complicated agility drills where a Soldier’s athletic ability, understanding and execution will dictate speed, effective marksmanship is worthless in a confrontation if the shooter cannot hit the adversary they are aiming for with the first shot. This issue, at the surface level, is a simple correction of the marksmanship fundamentals of breathing, relaxing, sight alignment and trigger pull. However, placed within the context of a highly stressful environment, execution of the proper fundamentals becomes an entirely

different matter when stress levels are high and environmental complexity increases. Using combatives as another example, if a Soldier is learns a new technique that requires one to balance on one foot while manipulating an attacker's body (such as many judo techniques), the technique will fail without the ability to first balance oneself. This sounds very simple; however, many Soldiers do not consider that idea of slowing down and rethinking where movement initiates cannot be overstressed when trying to solve the functional paradigm.

Acceptance of new ideas facilitates a linkage between cognitive and neuroscience fields with performance that will maximize the benefits of the THOR3 program. Producing this linkage, which is the greatest challenge of the newly hired human performance staff, is a mainstay of the THOR3 program design. This will be a challenge for many reasons. One reason is the simple fact that every SOF Soldier is unique, with his or her own thoughts, perceptions (and pre-conceived schemas and prejudices) and understanding of action and learning. Another reason is that that unlike other academic fields that have concrete evidence to back up research, cognitive and neuroscience dances in the theoretical and abstract arena that takes into account several considerations and key features of the brain but has no concrete characterization of how the “system” works as a whole. Although researchers have made great strides to understand the brain and its intricate processes, the subject of human perception, emotions, and senses remain difficult to interpret. This dilemma causes great discomfort for those who argue vehemently that there is only one right way to train someone; however, the beauty of this dilemma appears when one considers that no two human beings are alike. Exponential opportunities abound for THOR3 professionals and other human performance specialists to express creativity and imagination in developing new, exciting program designs that provide a path for the SOF Soldier to reach his or her maximum potentiality in accordance with their own anatomical, physiological and psychological make-up. This also provides an opportunity to advance the understanding of tactical human performance.

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X. CONCLUSION

On a final note, it is necessary to remind the reader again that the program design outlined in this thesis is *a* system versus *the* ultimate solution to fighting fitness. New and exciting information about each chapter's subject continues to grow on a daily basis as research and practical application discovers new methods of improving human performance. This research fuels three final considerations for fundamental movement and program design that that will help to ensure the success of the THOR3 program.

It is the author's opinion that Intellectual curiosity is the first consideration to solving the functional paradigm, primarily because it facilitates an open mind to new ideas and concepts. This will ultimately enhance a Soldier's ability to correct movement deficiencies or dysfunctions, internalize new movement patterns, and instill mental awareness of external forces that may cause harm to the body. Concomitantly, intellectual curiosity also enables a Soldier to take personal responsibility to find the right methods while trying to answer the question of “fit for what?” Sorting through vast amounts of fitness literature suspect with human performance “experts” marketing irrelevant program designs, nutritional guidance, and rehabilitation techniques detrimental to enhancing SOF performance is difficult for many Soldiers in time-compressed environment. It is helpful for SOF Soldiers to remember that they are Soldiers first, not cyclists, ultra-runners, triathletes, judokas, weightlifters, or any other athletic endeavor they wish to pursue. Training for durability and resiliency should be at the forefront of a SOF Soldier's mind; the amount of weight lifted, the fastest run times, or matches one are good indicators of fitness, but not the sole focus of a human performance program design for SOF Soldiers.

Intellectual curiosity drives the second consideration, which is a required paradigm shift in mindset in which SOF Soldiers must see themselves as professional athletes versus “just” SOF Soldiers. With this mindset comes the

same critical analysis that professional athletes use when looking for the extra edge to make them better and play longer. SOF Soldiers must understand that the fitness achieved while training for and passing through SOF selection is just a stepping stone to getting stronger, faster, more agile, and most importantly, smarter in their training approach. Hopefully, the THOR3 program will compliment this mindset by offering the same quality and quantity of care afforded to NCAA, Olympic, and professional athletes.

A warning is required for those uninterested Soldiers as this point. Rest assured, as the body and performance begin to break down with age and injuries, human performance will come to the forefront of thinking at some point in time. It is unit and individual responsibility to instill and cultivate this intellectual curiosity, especially considering the SOF imperative that *humans are more important than hardware.* Remember again, an ounce of prevention is worth a pound of cure.

The last consideration, which ties in all aspects of this thesis, is that ultimately, a SOF Soldier's fundamental human performance goal is to survive, and functional movement is the foundation of a system created to ensure survival. While some specificity is necessary to achieve positive results in specific mission sets, and can elevate strength, power, and endurance in some movement patterns, forcing the body to work in only certain patterns can be detrimental over the long run, and cause fundamental movement compromise, but reverse basic mobility and stability in others (Cook, 2010). For the SOF Soldier, function movement maintenance is more a journey than a destination, and to reiterate what was stated previously, training, conditioning, and rehabilitation should have purpose, precision, and progression survivability, adaptation, and functional movement that will enable a Soldier overcome or integrate with whatever context the Soldier happens to find him or herself in.

These considerations, if taken seriously, will enable the THOR3 program to bring physical fitness training in line to prepare soldiers properly for the battlefield conditions faced during deployments. Much talk about this training

disconnect occurred throughout the years; THOR3 is the catalyst that many military members have long hoped for to bridge the gap between physical and mental training and battlefield reality. The author's ultimate THOR3 hope and vision is that as the program begins to take shape, it will influence the SOF community in such a way that this type of training becomes a way of life, not just something that is finished and forgot about during the physical training hours. The reason is simple: The mind and body are the foundation upon which to build all military skills; this is very often left out of the equation when the focus is constantly on new weapons and technology, and other aspects of the military industrial complex. When one strips all the badges, weapons, accoutrements, and awards that tell the SOF Soldier that he or she is “special or elite,” all that remains of the SOF soldier is the mind, body and soul. Without a solid foundation of mental thought processes and functional movement to build upon before adding the extras, then the chances of mental and physical failure, or at the very least, possible injury or mistakes will occur at a later time. This, in the author's opinion, is inexcusable when the lives of individual and others are on the line, and an enormous amount of money, time, resources, and trust are spent in other areas to prepare a soldier for mission accomplishment.

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APPENDIX A. SAMPLE FACILITY EQUIPMENT LIST (BOYLE, 2008)

Number	Item	Cost	Total
4	Power Racks	600	2400
4	Adjustable Benches	400	1600
8	Olympic Sets	500	4000
9	Plate Trees	495	4455
1	Dumbbells	4000	4000
4	Adjustable Cable Columns	1500	6000
8	Clean Blocks	100	800
4	Slide Boards	300	1600
16	Double Dumbell Racks	100	1200
8	20k bumpers	75	1600
5	10k bumpers	45	600
10	Airex pads	45	225
15	Airex mats	15	450
15	Lateral Resistors	15	225
20	Med Balls	30	225
3	Dynamax Med Balls	80	600
2	Med Ball racks	200	240
5	Stability Balls	30	400
30	Foam rollers	15	150
2	ABC Ladders	90	450
24	Flat rings	4	180
2	CAT Overspeed	75	96
3	Sleds	150	150
1	Functional Training Grids	230	450
1	Pro Bodyblade	199	230
3	Calf Rollers	50	199
5	30' hurdles	80	150
10	12' hurdles	10	400
10	6' hurdles	10	100
10	Hurdle extensors	7	70
6	Belts	15	90
6	Dip Belts	30	180
1	Extreme Balance Boards	100	100
2	Weight Vests	90	180
2	Sand bags	35	70
1	Scale	300	300
2	Back extension benches	600	1200
1	Set Plyo boxes	500	600
1	Precor Elliptical	4000	4000
1	Stepmill	2000	2000

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APPENDIX B. RANGER ATHLETE WARRIOR PHILOSOPHY

- The individual ranger is the regiment's most lethal weapon.
- You don't know how tough your next enemy will be. Assume he will be very tough.
- You do not know exactly what the physical requirement will be on your next mission. Assume it will be extremely demanding.
- Ranger missions require strength, endurance, and movement skills. Excelling in only one or two leaves you vulnerable to poor performance and/or injuries.
- Training hard is not enough; you have to train smart as well.
- As an individual, a team, a squad, or a platoon, you are only as strong as your weakest link. Do not have a weak link.
- Form matters. Master the exercise techniques and demand proper execution from your men.
- The body adapts to the stress you place upon it. This takes time. Cells are not necessarily on the same schedule as your head and your heart. In other words, be consistent; be patient, and think of improvement over weeks and months, not days. Follow the phased scheduling guidelines.
- Do not crush yourself every day. Respect the need for recovery. Raw scheduling is designed to build in some degree of recovery, but leaders must be attuned to their men and modify the training stress appropriately.
- Fuel the machine. Don't train well then blow it with a lousy diet. Have a plan for hydration and meals/snacks and stick to it.
- Take care of your injuries before they become chronic. Playing hurt is necessary on occasion, but do it too long and there may not be a therapy or surgery fix.
- Keep your head in the game. Historically, warriors have been defined more by their minds than their Bodies. Similarly, most athletes claim their performance is as much mental as physical, yet they seldom train or have a plan for developing mental toughness. Rangers need to recognize their ideal performance state and be able to call it up at a moment's notice.
- Bottom line: train right, eat right, sleep right, and keep your head in the game.

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APPENDIX C. DEVGRU TESTING AND EVALUATION

The tests utilized in the process are as follows:

- Regular PRT plus command functional tests:
  - Pull ups (minimum 15)
  - Sit ups (minimum 90 in 3 min)
  - Push Ups (minimum 80 in 3 min)
  - 3 mile run in 22:30 or less
  - 0.5 swim in 14:30 or less
  - Pull ups with 25 lbs (min 10)
  - Bench press (body weight x min of 10 x)
  - 5 mile run in 37:30 or less
- Functional Tests:
  - 300-yard shuttle (to mimic demands placed on soldiers running during combat buddy movement/mount distance of 25 yards.
  - Box drill (to assess agility): 10 yard sprint, 10 yard shuffle, 10 yard back peddle, 10 yard carioca
  - Wall jumps (5 foot wall over as many x as possible in 90 sec – start position face down, feet touching wall, arms off surface facing away from wall)
  - Margaria Kalmen step test (implemented with the thought that it mimics house runs/Close Quarters Battle (CQB)
  - Swim/ladder climb: 50 m swim with 50 lb Alice pack (large frame ALICE pack with 35 pounds and floatation – 15 lb rucksack) followed by 24 foot caving ladder climb to mimic ship boarding.
  - Rope pull/Dummy drag: Pull 90 foot (30 yards) fast rope with 75 lbs of kettle bells for time followed by dummy drag of 185 lb dummy x 60 feet.

Some of the tests have been eliminated (MK step, swim/ladder, and rope dummy) but the ones who seem to be consistent are the 300-yard shuttle, box agility, and wall jumps. Broad jump (lower body power), and the pro-agility were added in place of removed tests.

APPENDIX D. REHABILITATION EXAMPLE OF SPA AND PLUNGE PROTOCOLS

A. SPA AND PLUNGE PROTOCOLS

1. Contrast Water Therapy (Spa / Plunge)

Ideally used at the end of a training day- do not use if you have damaged muscles, a very recent injury or bruising.

- Shower before use
- 2 minutes spa
- 1 minute plunge (Try to relax as much as possible!)
- Repeat 4–5 times
- Always finish on cold (plunge)
- Re-hydrate before, during and after session

2. Cold Water Immersion (Plunge)

Ideally used following a heavy weights session, between training sessions or during the acute phases of muscle injury, soreness or bruising. Try to build up a total of five minutes in the plunge pool.

- Shower before use
- 1 minute plunge (Try to relax as much a possible!)
- 2 minutes out of water (air temperature)
- Repeat 4–5 times

B. SPA

Spas can be used at the end of a day or on a rest day as a relaxation technique. Do not use if you have damaged muscles, a recent injury or bruising.

- Shower before use
- Do not use spa for extended periods of time (no greater than 10-15 minutes)

- Always re-hydrate while using the spa
- Stretching and jet massage can be utilized in the spa environment

C. GENERAL PRECAUTIONS

Do not use the spa/plunge facilities if you have any of the following:

- A history of heart disease
- A cold or virus
- An open wound
- Bruising
- Diarrhea
- Recent injury (Calder, 2005)

APPENDIX E. COMMON NUTRITION PRINCIPLES

- Varying the diet (helps to provide more health-protective nutrients)
- Follow a high carbohydrate diet (low carbohydrate diets reduce glycogen, which is critical for energy)
- Consume enough calories (Soldiers must consume enough calories to power through hard training and recovery periods. Caloric requirements are largely based on age and sex, training intensity, and other considerations)
- Stop mega-dosing (The myth that taking more food and supplements than necessary to build muscle is not true. Soldiers should consume the right amount of nutrients for muscle building; referring back to number 3, the right amount is based on individual needs) (Kleiner, 1998)
- Fuel your body on a regular schedule (eating every two to four hours is better than eating one or two meals a day)
- Eat when you are hungry, and stop when you are content (large meals lead to overeating and poor health)
- Take mealtimes seriously (Shut off the television, try to pry away from distractions and focus on food preparation and intake. This will allow more focus and energy toward making the right food choices) (Clark, 2008)

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